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PROCEEDINGS OF THE NATIONAL CONFERENCE  
ON PROTECTIVE CLOTHING AND SAFETY  
EQUIPMENT FOR PESTICIDE WORKERS HELD  
IN ATLANTA, GEORGIA, MAY 1-2, 1972

Federal Working Group on Pest Management  
Rockville, Maryland

June 1972

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Proceedings of the  
**NATIONAL CONFERENCE  
ON PROTECTIVE  
CLOTHING AND  
SAFETY EQUIPMENT  
FOR PESTICIDE WORKERS**

MAY 1-2, 1972  
CENTER FOR DISEASE CONTROL  
ATLANTA, GEORGIA

Sponsored by  
THE FEDERAL WORKING GROUP ON PEST MANAGEMENT

Conducted by  
THE SAFETY PANEL

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## AGENDA

### NATIONAL CONFERENCE ON PROTECTIVE CLOTHING AND SAFETY EQUIPMENT FOR PESTICIDE WORKERS

Sponsored by  
The Federal Working Group on Pest Management

**Time:** May 1-2, 1972

**Place:** Center for Disease Control (CDC)  
1600 Clifton Road  
Atlanta, Georgia 30333

**Purpose of Conference:** To assess the current levels of significance, technology, regulations and acceptance regarding protective clothing and safety equipment for protection against harmful effects of pesticides

**Attendees:** Selected participants from the following disciplines and groups – pesticide toxicology, agricultural and industrial pesticide users, pesticide and hazardous chemical regulatory authorities, accident investigation personnel, pesticide safety personnel, pesticide manufacturing plant managers, protective clothing and safety equipment producers and specification specialists, members and affiliates of the Federal Working Group on Pest Management

#### Program

##### May 1, 1972

|                       |                                                                                                                                                                                                |
|-----------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 8:00 a.m. - 8:30 a.m. | Registration                                                                                                                                                                                   |
| 8:30 a.m. - 8:35 a.m. | Welcome – <i>Dr. David J. Sencer, Director, CDC, and Assistant Surgeon General, DHEW</i>                                                                                                       |
| 8:35 a.m. - 8:45 a.m. | Remarks on FWGPM – <i>Dr. Fred H. Tschirley, Chairman, FWGPM, and Pesticides Coordinator, USDA</i>                                                                                             |
| 8:45 a.m. - 9:00 a.m. | Introduction and Charge – <i>Dr. W. H. Preston, Jr., Chairman, Safety Panel, FWGPM, and Associate Director for Standards, Pesticide Regulation Division, Office of Pesticide Programs, EPA</i> |

##### Section I: The Significance of Protecting Man from Exposure to Pesticides

|                        |                                                                                                                                                                                                               |
|------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9:00 a.m. - 9:45 a.m.  | Effects of different kinds of exposures and different kinds of pesticides on man, as determined through laboratory testing – <i>Dr. John Davies, Department of Medicine, University of Miami, Miami, Fla.</i> |
| 9:45 a.m. - 10:30 a.m. | Protection of individuals who mix or apply pesticides in the field – <i>Mr. Homer Wolfe, Chief, Wenatchee Research Station, EPA, Wenatchee, Wash.</i>                                                         |



## **Agenda (Continued)**

### **Section II: Types of Protective Clothing and Safety Equipment**

- 11:00 a.m. - 12:00 p.m. Protective clothing, goggles, gloves and foot coverings - their value during handling and use of pesticides - Special Panel: *Mr. William Andresen (Leader), Director, Industrial Hygiene and Safety, American Cyanamid Co., Wayne, N. J.; Mr. M. F. Shields, Technical Sales Representative, Willson Products Division, Environmental Services Branch, Redding, Pa.; Mr. C.R.E. Merkle, Jr. Mine Safety Appliances, Pittsburgh, Pa.; Mr. William S. Colehower, Jomac Products, Warrington, Pa.*
- 12:00 p.m. - 12:30 p.m. Effectiveness of respirators and similar gear for protection against inhaling pesticides - *Mr. C.R.E. Merkle, Jr., Mine Safety Appliances, Pittsburgh, Pa.*
- 1:30 p.m. - 2:00 p.m. Ventilation and dust control systems to protect workers in enclosed areas - *Dr. Robert Scott, Vice President, Manufacturing, Chemagro, Kansas City, Mo.*
- 2:00 p.m. - 2:30 p.m. Innovations in pesticide application equipment that protect workers from exposure to pesticides - *Mr. John Hagie, Power Sprayer and Duster Council, Farm and Industrial Equipment Institute, Chicago, Ill.*

### **Section III: Laws and Regulations Regarding Protective Clothing and Safety Equipment for Workers Handling and Using Pesticides**

- 3:00 p.m. - 3:30 p.m. Occupational health and safety standards that apply to pesticide exposure situations where protective clothing and safety equipment are needed - *Mr. Charles Wilson, OSD, Occupational Safety and Health Administration, DOL, Washington, D. C.*
- 3:30 p.m. - 4:00 p.m. Regulations governing hazardous chemicals in loading and transportation operations where protective clothing and safety equipment must be available - *Mr. Judge R. Shelton, Deputy Chief, Compliance Division, Bureau of Motor Carrier Safety, DOT, Washington, D.C.*
- 4:00 p.m. - 4:30 p.m. Rules for workers in warehouses where storage of hazardous chemicals necessitates availability and use of protective clothing and safety equipment - *Mr. H. Moss, Jr., Product Distribution Manager, Agricultural Division, Shell Chemical Co., San Ramon, Cal. 94583*

**May 2, 1972**

- 8:15 a.m. - 8:30 a.m. Percutaneous penetration of pesticides through the human skin - *Dr. Howard Maibach, Department of Dermatology, UC Medical School, San Francisco, Cal.*

### **Section IV: Habits and Practices of Workers Relative to Desire for, Need and Actual Usage of Protective Clothing and Safety Equipment**

- 8:30 a.m. - 9:00 a.m. Attitudes and practices of pesticide applicators regarding necessary and regular use of protective clothing and safety equipment - *Mr. Mills Rogers, Rogers Entomological Service, Cleveland, Miss.*

**Agenda (Continued)**

9:00 a.m. - 9:30 a.m. — Pesticide Worker Accidents — What's Happening — *Mr. W. J. Fletcher, Agricultural Safety Engineer, National Safety Council, Chicago, Ill.*

9:30 a.m. - 10:00 a.m. — Some psychological explanations for disregarding safety rules and some inducements to correct the problems — *Dr. Frank J. Vilardo, Research Associate, Highway Safety Research Center, UNC, Chapel Hill, N. C.*

**Section V: Panel Workshop — Assessment of needs and the formulation of recommendations for research, regulations, improved information dispersal and alternative practices — Panel subject matter assignments have been limited to specific areas where pesticides and people are in close proximity and where safety clothing and protective equipment may need to be available or in use.**

Panel No. 1: Manufacturing and Formulating Plants

Panel No. 2: Loading and Transportation Situations

Panel No. 3: Storage and Warehousing Environments and Dealers and Distribution Outlets

Panel No. 4: Farmer and Farm Worker Practice in Application and Use of Pesticide Products

Panel No. 5: Commercial Applications and Use of Pesticide Products

Panel No. 6: Activities Following Use — Decontamination and Disposal, Field Re-Entry

10:00 a.m. - 10:30 a.m. — Instruction and assignments

11:00 a.m. - 12:30 p.m. — First session of workshop

1:15 p.m. - 2:30 p.m. — Second session of workshop

2:45 p.m. — Turn in reports to Conference Chairman

**Section VI: The Concern of the Federal Government for the Safety and Protection of Workers Exposed to Potentially Hazardous Situations**

3:00 p.m. - 4:00 p.m. — Keynote Speaker — *Mr. George Larry Wyatt, Occupational Safety and Health Administration, DOL, Atlanta, Ga., Regional Office*

**SAFETY PANEL  
of the  
FEDERAL WORKING GROUP ON PEST MANAGEMENT**

**Department of Defense**

*Mr. Charles M. Buxton, Defense Supply Agency  
LTC Marshall Steinberg, U.S. Army Environmental Hygiene Agency  
Dr. P. G. Waldrep, Defense Supply Agency*

**Department of the Interior**

*Mr. Calvin M. Menzie, Bureau of Sport Fisheries and Wildlife*

**Department of Agriculture**

*Mr. John R. George, U.S. Forest Service  
Dr. Leonard C. Gibbs, Extension Service (Vice Chairman, Safety Panel)  
Mr. Charles L. Mangum, Animal & Plant Health Inspection Service  
Dr. J. R. Plimmer, Agricultural Research Service  
Dr. Warren C. Shaw, Agricultural Research Service*

**Department of Health, Education, and Welfare**

*Mr. William F. Barthel, Center for Disease Control  
Dr. H. F. Kraybill, Food and Drug Administration*

**Department of Transportation**

*Mr. Willis F. Mitchell, Office of Hazardous Materials*

**Environmental Protection Agency**

*Mr. Timothy Fields, Office of Solid Waste Management Programs  
Dr. William H. Preston, Jr., Office of Pesticide Programs (Chairman, Safety Panel)  
Mr. Charles D. Reese, Office of Water Programs*

**Department of Labor (Liaison)**

*Mr. Charles Wilson, Occupational Safety and Health Administration*

**Federal Trade Commission (Liaison)**

*Mr. Stanley J. Gilmore  
Mr. Tenny P. Neprud*

**National Agricultural Chemicals Association (Industry Liaison)**

*Mr. Denis Hayley  
Mr. John M. Stackhouse*

**RECOMMENDATIONS OF THE SAFETY PANEL**

**TO THE**

**FEDERAL WORKING GROUP ON PEST MANAGEMENT**

**SAFETY PANEL**  
of the  
**FEDERAL WORKING GROUP ON PEST MANAGEMENT**

**Recommendation No. 1**

*Undertake as rapidly as is feasible studies to determine the effectiveness of barrier creams in reducing the hazards of pesticides to users; if available barrier creams are found inadequate, undertake research to develop effective barrier creams.*

**Background**

The restrictions imposed on organochlorine pesticides have increased the use of highly toxic materials, particularly, organophosphates. The hazard of these materials to their users has been dramatically evidenced by an increase in pesticide accidents, illnesses and deaths. It has become necessary to enlist any and all feasible measures to reduce these hazards.

While the use of soap and water should not be discouraged, this Conference was presented with information that indicated extremely limited effectiveness of water in reducing contact hazards of pesticides. The need for protection is constant and immediate, and effective barrier creams could partially fulfill this role.

**Implementation**

A study should be developed by DHEW, with the cooperation of DOL and other agencies, as needed.

**Recommendation No. 2**

*Develop basic, practical guidelines for use of safety equipment and protective clothing by persons producing and/or using pesticide chemicals, especially the more toxic products.*

*These guidelines, to be most effective, must be widely publicized through visual aids and other means and developed by a source adept at communicating with plant workers and the agricultural community.*

**Background**

It is essential that these guidelines be broad in application as workers are generally reluctant to wear or to use safety equipment at any time. Protective equipment meeting minimum requirements stands a much better chance of being used than equipment which is confining or unsuitable.

**Implementation**

It is suggested that these guidelines be developed by an ad hoc committee of industry's occupational health and safety personnel, representatives of the Extension Service and the Agricultural Research Service of USDA, a representative of DOL and a representative of the National Safety Council.

The development of visual aids and other informational material should be by the appropriate divisions of USDA and DOL.

**Recommendation No. 3**

*Develop a test, evaluation and research program on available protective clothing and safety equipment designed for workers who handle, store, transport, use and dispose of pesticides.*

**Background**

There is a great need for providing pesticide workers with and encouraging them to use protective clothing and safety equipment to protect their health.

There is special need to conduct research to develop standards for rubber or rubberized and other impervious types of protective gear such as goggles, footwear, aprons, headgear, jackets, etc., for pesticide workers which will foster:

User acceptance

User safety and comfort

Minimal user care and maintenance

Currently, no organization is testing and evaluating most of the available protective clothing and safety equipment for pesticide handling. The last such USDA report concerning respirators and entitled "Respiratory Devices for Protection Against Certain Pesticides" (ARS 33-76-2) was issued in February 1966. Pesticide workers are confused and ill-advised on the current merits and need for using protective clothing and pesticide safety equipment.

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#### **Implementation**

DHEW should assume the responsibility for testing and evaluating the various types of protective clothing and safety equipment for pesticide workers. This should be done in cooperation with EPA, USDI, USDA, DOT, DOL, DOD and others, as applicable.

#### **Recommendation No. 4**

*Conduct a study to determine if safety gear used for protecting handlers and users of pesticides could be sufficiently standardized to permit greater interchange of parts, provide easier maintenance and repair, be simple and practical in design and be widely applicable and available.*

##### **Background**

There are hundreds of items of safety equipment available for use by pesticide handlers. This leaves handlers at a loss to know which to choose and whether the chosen equipment will provide the specific protection needed. Respirators are an example of equipment that is available and can provide effective protection, but often those that need the equipment do not know which to choose. After purchase, users often experience difficulty in replacing filters and parts as they move to areas serviced by different suppliers. Standardization would alleviate many of these difficulties and could provide encouragement to properly maintain equipment and to use it when needed.

##### **Implementation**

Feasibility for developing such a study should be jointly investigated by industry's occupational health and safety personnel, representatives of DOL and DHEW and a representative of the National Safety Council.

#### **Recommendation No. 5**

*Conduct a study to determine variables encountered in providing each farm worker handling pesticides a readily available whole-body washing facility and change of clothing immediately following routine application or because of a pesticide mishap. Such a study must encompass a random, stratified crop survey of varyingly toxic pesticides as used geographically.*

*To assure the acceptability of a washing facility, a time factor must be established that would insure effectiveness in preventing a harmful amount of toxic material from being absorbed into the human body.*

##### **Background**

From evidence presented at this Conference and from discussions during the workshop sessions, it is evident that additional information and research are needed to determine the needs of the farm worker in removing a pesticide from the body. This would apply primarily to the worker who is required to handle those pesticides that may be highly toxic or have an accumulative effect. This Conference also emphasized that many of the practices presently used in the field may not protect the workers and some may in fact speed up the rate of entry of the substance into the body.

##### **Implementation**

The Federal Working Group on Pest Management requests the assistance of the Extension Service, USDA, in distributing to each of the county extension agents a questionnaire to assist in determining needs, number of units in question, areas or type crop where facility would be feasible, and minimum requirements of units to meet emergency needs. From this basic information it is suggested that an in-depth study be contracted with an organization such as the Institute of Agricultural Medicine, University of Iowa, to fulfill this recommendation.

#### **Recommendation No. 6**

*Propose a federal standard for storage and warehousing of pesticides.*

##### **Background**

No uniform standards for warehousing of pesticides are now in use. Undue hazard exists from offices and even living quarters in or over warehouse space. Adequate facilities for sanitation and personal protection are not only not available in many cases, but even the need for such facilities may not be understood. In case of fire, runoff from sprinkler systems or hoses may create a serious problem not only to the emergency fighters but to cleanup crews and to those living in the area. In addition, serious environmental problems could ensue. By far one of the most seriously neglected areas is that of protective equipment and supplies, including the need for at least some educational material to inform the workmen and officers in a warehouse of the problems and hazards of handling pesticides. In addition, strict rules for storage of pesticides must be in effect to prevent contamination of food, feed, clothing and other materials.



#### **Implementation**

A federal code of storage and warehousing of pesticides should be developed for administration by appropriate federal departments to supplement their existing responsibilities in the handling of hazardous materials.

#### **Recommendation No. 7**

*Develop local pesticide disaster teams under official auspices to handle emergencies posing a hazard to health or to the environment.*

#### **Background**

Transportation and storage of toxic chemicals and pesticides have increasingly become a part of the normal commerce in all parts of the country. Such commerce occasionally poses a hazard to the public health and to the environment through accidents, spills, fires, explosions and natural disasters of wind and water. Proper handling of such incidents requires a high degree of varied technical training and experience not ordinarily available at the site. Therefore, to deal immediately, expertly and safely with such emergencies, a properly equipped manpower pool of technical expertise under official auspices should be developed locally to immediately assist householders; farmers; businessmen; fire and police departments; agricultural, conservational, environmental and public health officials in properly handling emergency incidents involving pesticides and similar chemicals.

Some localities already provide limited services for expert emergency assistance through local and state agricultural, educational and public health agencies. The facilities and special expertise of the pesticide industry are available to the public through the National Safety Team Network. There is a need to expand this type of activity through countrywide development of similar local safety teams drawn from state and local official agencies and from other available local talent in the private sector. Such teams would be readily available to coordinate their efforts with official local governmental jurisdictions as required and also to coordinate their activities with appropriate state and federal agencies where indicated.

Additional functions of the local pesticide disaster team would be to advise local fire departments on the location and types of pesticide storage and potential hazards involved in case of a disaster and to advise the local fire and police departments on special fire-fighting procedures and precautions and on emergency evacuation plans. Disaster teams formed under this recommendation would also coordinate with and augment any pesticide protection teams organized in accordance with Recommendation 9 of the Mrak Commission Report, Part I. Needs for specific types of protective equipment should be determined by area disaster teams in accordance with local conditions. Availability and proper use of such equipment would be another function of the disaster teams.

#### **Implementation**

Pesticide disaster teams should be organized under state or local authority in conformity with prevailing jurisdictional responsibilities for pesticide safety. The efforts and training of local disaster teams should be coordinated by Civil Defense to deal adequately and promptly with any major pesticide emergency.

#### **Recommendation No. 8**

*Re-establish a task group to develop a coordinated pesticide accident and incident reporting system.*

#### **Background**

One important basis for determining corrective actions to reduce hazards from pesticides is use of information from pesticide accidents and incidents. This was pointed out several times during the Conference, where need for information on how, when and what safety gear should be available was discussed.

The Safety Panel recognizes the previous history regarding the original task force set up as a result of action by the Federal Committee on Pest Control and feels that a new task force should be formed. There are, perhaps, several more agencies that may be able to provide input and assistance that were not available earlier.

#### **Implementation**

The Safety Panel can provide direct assistance to the Working Group to restart this study, if this seems helpful or necessary.

## **INTRODUCTORY REMARKS**

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## WELCOMING STATEMENT

*David J. Sencer, M.D.  
Assistant Surgeon General  
Director, Center for Disease Control*

I take particular pleasure in welcoming this group to CDC because of the historical relationship we share. The beginning of this relationship was some years before I came to CDC; many of you may be unaware of it; mention of it may be a source of nostalgia to others. You see, the Center for Disease Control is the direct descendant of an emergency World War II agency – the Office of Malaria Control in War Areas, MCWA for short – set up to work with State health departments in some 2,200 localities in 19 malarious states to protect civilian personnel employed in critical industries and military personnel in extra-cantonment areas.

Larviciding was the anti-anopheline method of choice. Diesel oil, Paris green, and pyrethrin emulsion were used until DDT became available in 1945. It was the widespread use of DDT in malaria control, and then in the control of other vectorborne diseases, that led to the establishment of our world-renowned Technology Branch, later known as the Pesticides Program, which is now a part of the FDA. The Technical Development Laboratories in Savannah, which are still a part of CDC, were given responsibility for testing and developing pesticide formulations, evaluating toxicological hazards of pesticides, and developing equipment for applying pesticides. All of these contributed to the increased efficiency and safety of operational methodology.

Pesticides are still related to health, although many people think of them chiefly in connection with agriculture. Certain species of mosquitoes and other arthropods transmit diseases to people, and so control of them is a public health problem. The Venezuelan equine encephalitis outbreak in Texas last year, which caused at least 88 human cases and more than 1,000 deaths in horses, is an example of a present-day mosquitoborne disease. Rodents and their ectoparasites carry diseases to man; plague is historically the most awesome of these diseases. Even aquatic snails in many areas of the world play a role in the life cycle of a blood fluke that causes a miserable disease – schistosomiasis or Bilharzia – in millions of people. Molluscicides are used to control the snails, and herbicides to control the aquatic vegetation that harbors them. CDC's continuing concern with pesticides is focused on their role in public health and on protecting the health and well-being of the people who formulate and apply them.

We are happy to have you here. You have brought back many of our old friends and coworkers and introduced new friends who are fellow workers in a common cause – helping to make a better life for our people. We wish you a successful, meaningful conference. Please let us know if we can be of help to you.

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## OPENING REMARKS ON FEDERAL WORKING GROUP ON PEST MANAGEMENT

by

*Dr. Fred H. Tschirley*  
*Chairman, FWGPM*

Welcome to the National Conference on Protective Clothing and Safety Equipment for Pesticide Workers. As Chairman of the Federal Working Group on Pest Management – the organization which is sponsoring this meeting – I thought it would be helpful to briefly outline the organization and function of the Federal Working Group.

The Federal Working Group on Pest Management is unique on the Washington scene in that its genesis is based on a voluntary agreement by Department Secretaries, and not on legislation or Executive Order. This is significant, since collaboration forced by outside authority sometimes produces stand-offs or outright confrontations with resulting interference in the very purposes requiring collaboration. In 1961, as a response to Presidential concern for interagency coordination in the use of pesticides, a voluntary agreement by the Secretaries of Agriculture; Defense; Health, Education and Welfare; and Interior; created the Federal Pest Control Review Board. This was purely an advisory board, composed of two members from each of the participating Departments, charged to provide joint review and coordination of all major federal pesticide use programs.

In 1964, in response to the President's Science Advisory Committee on Use of Pesticides, a charter was signed by the Secretaries of the four Departments formally creating the Federal Committee on Pest Control which superseded the Pest Control Review Board. Sub-committees on Program Review, Monitoring, Safety, Research and Information were subsequently added to assist the parent FCPC in its broadened scope and responsibilities. The replacement of the FCPC by the Working Group of the Sub-committee on Pesticides, President's Cabinet Committee on the Environment was announced by the White House in November 1969. The charter of the Working Group was published in the Federal Register on March 26, 1970. When Executive Plan III became effective in July 1970, the Cabinet Committee on the Environment was dissolved, although the Working Group continued to perform its functions. In October, by White House memo to the Chairman of the Council on Environmental Quality, the Working Group on Pesticides was made responsible to CEQ and its membership was expanded to include the Departments of Transportation, Commerce and State as well as the Environmental Protection Agency, CEQ, the Office of Science and Technology, Office of Management and Budget, and the Office of Intergovernmental Relations were also invited to participate as observers in deliberations of the Federal Working Group. In late 1971 along with publication of an updated charter, the name was officially changed to its present form – The Federal Working Group on Pest Management.

The Working Group is the primary coordinating mechanism for all federal activities in the general field of pesticides and pest management. It develops program and policy proposals and provides day-to-day coordination of Federal Pest Management programs for user agencies, regulatory agencies, health agencies, and conservation agencies. This coordination is provided through the input of over 100 scientist-administrators of diverse disciplines from member and observer agencies as well as some segments of industry, state and international agencies, and academic institutions.

Some specific activities of the Working Group include:

- a. Review of all federally sponsored pest control programs for compliance with label requirements and for the purpose of preventing unnecessary environmental contamination; where an alternate non-chemical method is available, such method is recommended as a substitute;
- b. Identification and coordination of research needs on pests and pest management systems;
- c. Monitoring for pesticide residues in the environment;
- d. Dissemination of information on pests and pest management systems;
- e. Development of training programs that will result in an adequate level of competence by federal employees responsible for prescribing and utilizing various pest control techniques; and
- f. Identification, development and coordination of safety measures in the use and disposal of pesticides.

It is in direct response to this last named activity that you ladies and gentlemen were invited to this National Conference on Protective Clothing and Safety Equipment for Pesticide Workers. Members of the Safety Panel of the Working Group have identified a need to assess the current levels of significance, technology, regulations and acceptance regarding protective clothing and safety equipment for protection against harmful effects of pesticides.

The largely unpublished activities and accomplishments of the Working Group are numerous and significant. For example, the Safety Panel has previously held a conference on the disposal of surplus pesticides. Out of this conference came four publications — A Summary of Interim Guidelines for the Disposal of Surplus or Waste Pesticides and Pesticide Containers; Ground Disposal of Pesticides; Disposal of Surplus Pesticides; and Disposal of Surplus Pesticides, Empty Containers and Emergency Situations. Detailed information on these safety related publications is outlined in a flier which is available at the registration desk. Today's conference is the latest example of the type of effort, related to safe use of pesticides, to be undertaken by the Working Group.

Let me now turn the program over to the Chairman of our Safety Panel, Dr. William H. Preston.



## INTRODUCTION AND CHARGE

by

*Dr. W. H. Preston, Jr.  
Chairman, Safety Panel*

I am pleased to greet so many people interested in the important topic of saving lives of working people. I say working people because those who handle and use pesticides usually are people used to hard, hot, and heavy work. They know — and you know — that these pesticide tools are a means of saving work, insuring livelihoods, and making a better quality of life for all of us. But these tools must be handled and used carefully and wisely — just like the automobile — or else we'll get into trouble. Where do we stand in the use of protective clothing and safety equipment for pesticide workers? Do we need more research in some areas? Should regulations be promulgated in certain areas to enforce availability and/or use of the protective materials and devices? Is there need for a more effective information dispersal program? To help answer these questions, we've invited participants to this meeting from many walks of life — toxicologists, chemists, farm applicators, entomologists, transportation officials, pesticide inspectors, even a few Federal Officials — all of whom have a special interest in seeing that pesticides are safely handled and used, and that workers are properly protected.

The Conference is designed *not* just as a training class to sit and learn things, but to sharpen and broaden your perspectives for later input on the Panels. It is *not* a reunion of old friends and acquaintances, but a group of divergent people and ideas to be brought together for a common worthwhile cause. It is not a meeting of scientists gathered to discuss a specific phenomenon, but an assembly of people from many walks of life to view the working man and his pesticide tool from both the practical and scientific standpoint, and come up with some ideas for better protection in the future.

Thus, the Conference is designed to get your input, your ideas, your observations, and your experience. The speakers have been selected to lead you in the directions of the importance of protection from pesticides exposure, what protection we have to offer the worker today, what regulations are in effect that protect workers who handle or use pesticides and what the worker does himself to provide or not provide the protection he needs. Your job will be to combine these directions with your own knowledge and experience, then put together your conclusions with those of the other participants to come up with recommendations to improve the lot of the worker.

The Safety Panel of the Federal Working Group on Pest Management is seated here on the stage, and I wish to let you get better acquainted with them. (Introduction of each Panel member present.) These men are charged with the responsibility of identifying problem areas related to aspects of safety in marketing, packaging, storing, transporting, distributing applying and using, and disposing of pesticides. They must survey current research programs, and review pertinent policies and regulations. They must then recommend appropriate action to bring about solution or alleviation of the problems selected for study. And this season, one of our major selected problems is protective clothing and safety equipment. Not nearly enough evidence of available kinds of protective clothing and safety equipment was apparent when Stan Gilmore headed an ad hoc committee to look into this situation several months ago. Evidently, much that is known is not yet written, and we needed information from you to bring us up-to-date.

The Safety Panel members will work with you and your information during the conference, and participate with you in the development of ideas and recommendations.

The speeches scheduled at this Conference will be published as part of the proceedings of the Conference. Each speaker is reminded that the spoken speech may deviate considerably from the written one due to use of slides, additional explanations, and time allowances. I do suggest, however, that each speaker provide as rapid delivery as possible to make certain there will be some time for discussion before the next scheduled speaker.

Any speaker or participant is welcomed to contribute remarks on special subjects that will add information and scope to the Conference. We invite many such remarks to be supplied later, if possible, in writing so that they may be entered as written remarks and published as part of the Proceedings. Such remarks may be written as briefly or lengthy as deemed necessary to be appropriate. In designing the Conference, we realized that many who were invited but could not be scheduled to speak in the formal program might have worthwhile contributions which would make the proceedings more valuable to everyone. Written remarks should be supplied during or as soon after the Conference as possible — preferably within about 5 days following the Conference.

Recommendations will be the third part of the published proceedings of the Conference. Every participant has an opportunity to have a hand in this. These will be developed from the six panels set up during tomorrow's program. We recommend that you take notes as you feel necessary to help you come up with the recommendations for research, better information dispersal, regulations, or other proposals that may be developed.

We hope to publish the Proceedings within 3-4 weeks following the Conference, which means that the Safety Panel will be as busy after the Conference as it was before the Conference. We felt that proceedings of meetings such as this are far more meaningful and useful if they are available as soon after the Conference as possible. This means rapid editorial and typing work, rapid printing, and rapid mailing to accomplish this.

We appreciate your help, interest and participation and look forward to the contributions and progress that will come from your efforts.

## **PRESENTATIONS**

## EFFECTS OF DIFFERENT TYPES OF EXPOSURE OF DIFFERENT KINDS OF PESTICIDES ON MAN AS DETERMINED THROUGH LABORATORY TESTING\*

by

*John E. Davies, M.D., M.P.H.  
Department of Medicine  
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### Introduction

Human pesticide exposure can be classified as acute, occupational, and incidental (Figure 1). Although by the use of such terms, there is an implication that exposure can be sharply delineated into these three classes, this is not really the case and the pesticide worker, during his lifetime will move through a continuum of exposures of these three categories. There may be times when he sustains an acute exposure and then again, there will be times when his work situation is so controlled that his pesticide exposure is minimal and differs in no way from the incidental exposure of the general population.

It is not easy to design a meaningful Pesticide Exposure Index (PEI) because there are so many host, agent and environmental variables which modify man's actual exposure; and industrial hygiene practices in pesticide protection have so improved in the developed countries that it is no longer meaningful to categorize pesticide exposure on the basis of such subjective variables as job descriptions and estimating quantities of the pesticides being handled. Human exposure is best measured by the laboratory and those expressions of exposures which reflect human biological and chemical indices of exposures are the best measurement of the PEI.

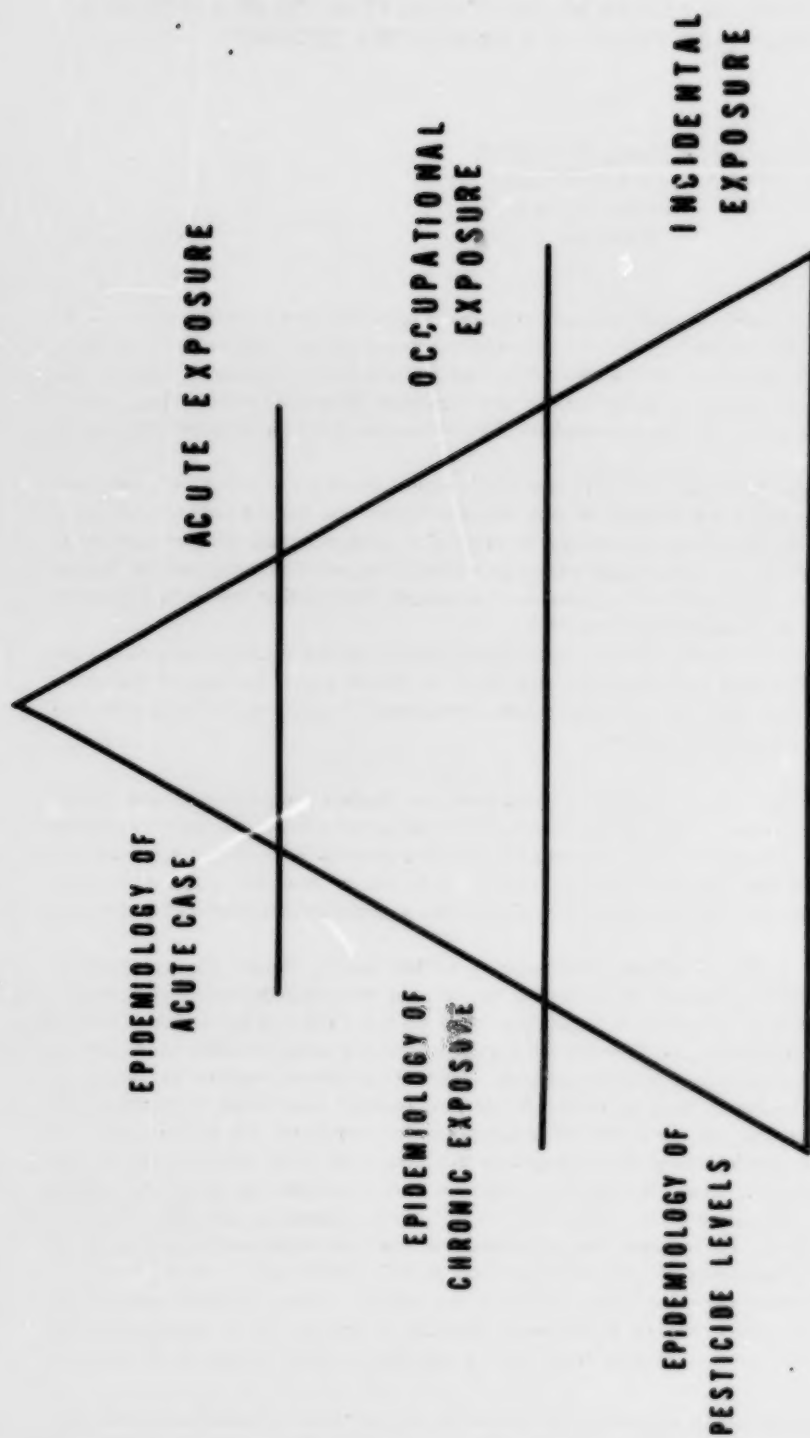
This paper will review the use of the laboratory in measuring the three categories of accidental, occupational and incidental exposure; will propose the growth of multi-disciplinary teams for the future, in the hope of uniting the agriculture and public health uses of pesticides so as to minimize these several types of exposures and to increase food production with the protection of man and his environment.

### Acute Exposure

In acute exposure, the exposure is such that a single dose is large enough to produce symptoms and signs of acute intoxication. Illness occurs because the dose is overwhelming or because it is sufficient to produce toxicity in a person whose defenses have been previously depleted through repeated sub-clinical exposures from chronic exposure. The former mechanism occurs with accidental poisonings in the home or with suicide attempts, whereas the latter mechanisms are usually operative in the pesticide exposed worker. Both types of exposure have produced acute illness in Dade County.

Figure 2 illustrates the descriptive profile of 145 poisonings occurring in Dade County, Florida. Two categories are recognized - adult poisoning and children poisoning. In the former, the race and sex preponderance of black males is to be expected because of the demographic profile of our agricultural work force in Dade County. In the light of the large numbers of agricultural chemicals available, parathion has the singularly infamous record of being responsible for 48% of all poisonings. The 37% case fatality rate in acute exposure reflects the inclusion of suicide and accidental cases. The problem of pesticide poisoning in children ideally should be considered as a totally preventable one, especially if the population at special risk and the source of poisoning can be recognized. Up until recently, this problem was almost always due to the accidental ingestion of parathion by a black male infant. In the last three years, a decline in infant poisonings has occurred, largely through the recognition of this population at special risk, and the use of widespread publicity by the local press alerting the public to the specific hazards of parathion, improved legislation keeping this out of the home, and increased law enforcement activities in finding and apprehending the unlicensed peddler of parathion. This improvement is not Statewide, and in 1970, 400 homes in the St. Petersburg area were found to have been treated with parathion which resulted in two deaths<sup>1</sup> - pesticide was still identified in the house dust, two years after its application. In rural Dade County, especially in the farm laborer's home, the illicit use of the more toxic organophosphate is still a problem. Significant cholinesterase inhibition is being found in our

\*The investigations reported herein were supported through contract No. 68-03-0088, with the Division of Community Studies, EPA, Chamblee, Ga. The views expressed herein are those of the investigators and do not necessarily reflect the official viewpoint of the Environmental Protection Agency.



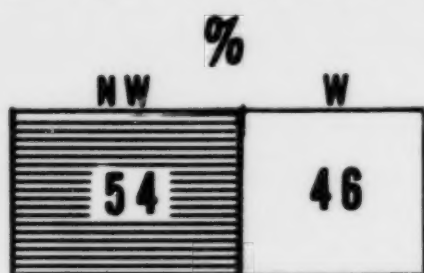
# STRATEGY OF PESTICIDE EPIDEMIOLOGY

Fig. 1



# EPIDEMIOLOGY OF ORGANOPHOSPHATE POISONINGS IN DADE CTY., FLA., 1963-68

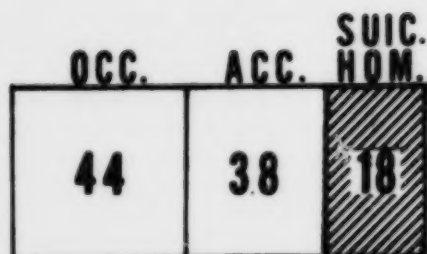
**ADULTS (85)**  
 $\bar{x}$  Age: 35, Range: 16-82



**RACE**



**SEX**



**MANNER**



**POISON**

**CHILDREN (60)**  
 $\bar{x}$  Age: 3, Range: 3/12-12

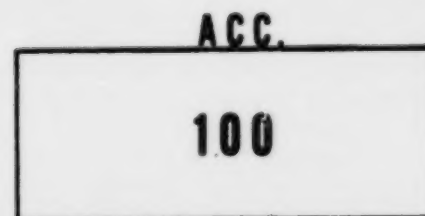


Fig. 2

migrant labor force -- both in adults and children. The investigation of this problem requires an appraisal of three mechanisms of exposure -- residue intoxication, individual domestic pest control practices, and the habit of geophagia. Recently in a large survey, 17% of farm laborers, pregnant women and children especially acknowledged eating soil, clay or starch, and the practice is as common in the Mexican-Americans as it is in the black agricultural workers. Recently, a 3½ y/o child of a Mexican-American laborer was admitted to the local hospital in respiratory arrest -- there was total cholinesterase inhibition and it was learned that she had been in the field that had been treated with Kelthane and parathion a few days earlier. With treatment she recovered and Kelthane was found in the blood and parathion in the gastric juices.

The role of the laboratory in this type of exposure is diagnostic, not only confirming the nature of the chemical but also providing information on the source and route of poisoning. In many cases of acute poisoning a clear cut history of exposure is not always forthcoming. Several very bizarre mechanisms of exposure have been reported and illness has occurred from a variety of sources of exposure ranging from the wearing of contaminated jeans<sup>2</sup> to the dermal exposures from a child sitting in a puddle of parathion<sup>3</sup>. Another mechanism, which is particularly problematic in the less developed countries stems from deficiencies of pesticide storage in the warehouse, and in transportation practices from the warehouse to the distribution centers. Often these buildings are poorly constructed and soon fall into disrepair. The floors may be earth rather than concrete and they are not infrequently in close proximity to food warehouses. Spillage is common owing to the damage of the pesticide containers in transit and serious soil contamination ensues. If the area becomes flooded during the rainy season, cross contamination of food in the adjoining warehouses can easily occur. This may pass unrecognized at the time and only later produce epidemics of poisoning, often in areas far removed from the original site of contamination.

The diagnostic tests that the laboratory can provide are: 1) cholinesterase measurements, 2) pesticide residue studies in food, soil and in the blood and gastric contents of the victim or in the blood, urine and hair if the agent is metallic, and 3) pesticide metabolite studies of the urine. The organophosphate and carbamate group of pesticides produce illness by cholinesterase inhibition. The most widely used methods of analyses are the automated pH stat method (titrimetric)<sup>4</sup> and the Michel method (electrometric),<sup>5</sup> but there are several colorimetric test kits for the field<sup>6</sup>. Although we have observed workers who are asymptomatic with red blood cell cholinesterase values of 0.1  $\Delta$ pH/hr., most of our poisoning cases have had RBC cholinesterase values below the 0.4  $\Delta$ pH/hr level (Michel). With occupational surveillance, when we don't have a pre-exposure baseline level, the 0.4  $\Delta$ pH/hr. is the level that we temporarily remove our exposed worker.

The urinary metabolite is another laboratory test which adds greater specificity to the diagnosis. The urinary data are also of use in the clinical management of the victim, providing toxicological information which is of use for the maintenance of atropine therapy. Concentrations of the parent pesticide in the blood provide similar but more specific etiologic data. Figure 3 illustrates the combined pharmacodynamics of these pesticide exposure indices in a 45 y/o agricultural worker acutely intoxicated through the spillage of parathion on to his clothes and a delay in changing these. The small squares represent the RBC ChE levels and show that his RBC ChE was almost totally inhibited on admission and rose to 0.6  $\Delta$ pH/hr. after repeated 2-PAM administration--the small circles reflect the parathionemic concentration which was on admission 23.8 ppb., rising to 47.5 ppb., and which later fell to the limits of sensitivity on the third day: the small triangles reflected the urinary paranitrophenol (PNP) concentrations. On admission the PNP was 14 ppm., then rose to 18 ppm. and by the middle of the third day had dropped to 2 ppm. at which time atropine therapy was discontinued.

#### Occupational Exposure

This exposure is usually sustained, multiple, and presents hazards of long-term high exposure as well as the risk of sustaining an acute excessive exposure with subsequent intoxication.

In most health studies of persons occupationally exposed to pesticides, apart from dermatitis, the finding of diseases associated with long-term exposure have been remarkably negative. Thus, Laws et al.<sup>7</sup> found no unusual illnesses in a group of pesticide manufacturers having a prolonged and high occupational exposure to DDT, and Jager<sup>8</sup> reported similarly negative findings using a wide variety of clinical electroencephalographic and biochemical tests in workers with long exposure to aldrin, dieldrin, endrin and telodrin. In 1970, in our Community Studies on Pesticides Program, we conducted 8,612 tests in 144 persons occupationally exposed to pesticides and compared these findings with 37 controls. There were no significant differences in age between the two groups and no significant differences between exposed and controls were observed in the following tests: hematocrits, hemoglobins, alkaline phosphatases, LDH, and Fasting Blood Sugars. Serum organochlorine and SGOT were significantly higher when compared to the controls and RBC and plasma cholinesterases and Phosphorous Reabsorption Index (PRI) were significantly lower in

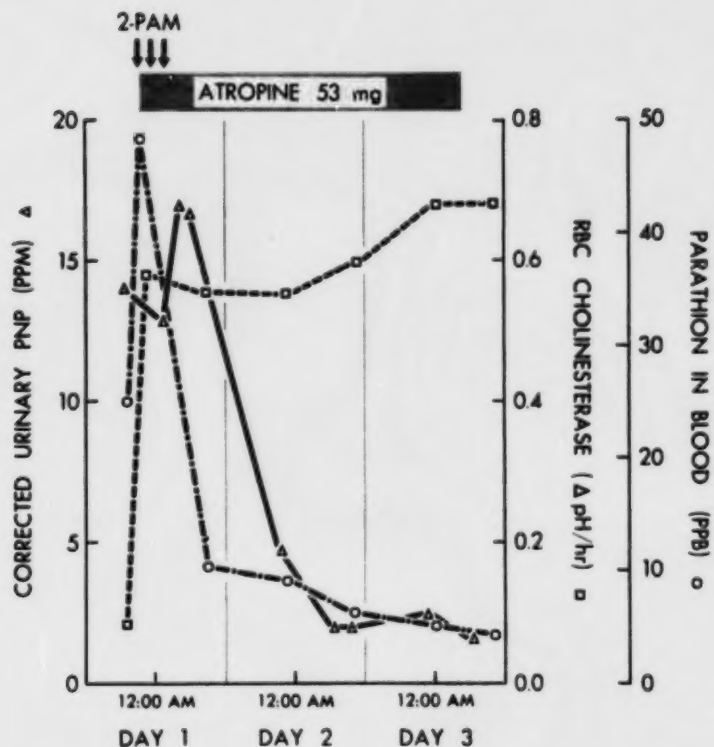


Figure 3 - The RBC sequential cholinesterase, blood parathion and urine PNP changes in a severe case of oral ingestion of parathion treated with three 1 gram doses of 2-PAM and 53 mg. of Atropine.

the exposed. Sixteen of the 98 exposed persons who were tested had diminished tubular reabsorption of phosphorous with PRI values of  $<0.86$ . This index is most reduced in acute parathion intoxication and the test is of value in acute parathion exposure rather than in the study of the pesticide exposed worker. Other biochemical changes have also been reported by Poland and Smith.<sup>9</sup> In 24 individuals having heavy exposure to DDT, cortisol metabolism, as reflected by 6-Beta hydroxycortisol excretions was increased by 57% and a 19% reduction of the phenylbutazone 1/2 life was also demonstrated. The average serum p,p'-DDT in these workers was 573 ppb. and p,p'-DDE was 506 ppb. In view of the relative absence of biochemical abnormalities and clinical anomalies in long-term high exposure groups, the major role of the laboratory in this category is human surveillance, its objective is to limit and prevent excessive human exposure. Cholinesterase testing, urinary metabolite survey and serum pesticide concentrations all have their uses for measuring pesticide exposure.

Table 1 illustrates the potential of the laboratory in occupational surveillance. This table gives the average monthly RBC ChE and urinary parathion of persons occupationally exposed to parathion in Dade County in 1965. Data were collected on the average amount of parathion handled, the percentage absenteeism, the average monthly ChE level and the weekly urine PNP concentrations. Persons who were assessed as being careful and well protected were handling 11.02 lbs. of 100% parathion daily and had an average daily concentration of PNP of 0.8 ppm. With this load, the absenteeism rate during the six-month period was 20% with a mean ChE level of 0.69 ΔpH/hr. (Michel). These were the same average levels for this enzyme in a group of formulators whose creditable work record was substantiated by having no absenteeism and a mean urine PNP of 0.9 ppm., in spite of handling 65 lbs. of 100%

**TABLE I**  
**AVERAGE MONTHLY RBC CHOLINESTERASE AND URINARY**  
**P-NITROPHENOL LEVELS OF PERSONS OCCUPATIONALLY**  
**EXPOSED TO PARATHION IN DADE COUNTY, 1965**

| Occupational Types              | No. | Av. amt. 100% Parathion Handled daily Lb. | % Absenteeism | ChE Level, pH/Hr. | No. of Samples | PNP P.P.M. | No. of Samples |
|---------------------------------|-----|-------------------------------------------|---------------|-------------------|----------------|------------|----------------|
| A. Careful & protected spraymen | 5   | 11.02                                     | 20            | 0.69              | 31             | 0.8        | 140            |
| B. Well protected formulators   | 4   | 65.5                                      | 0             | 0.69              | 26             | 0.9        | 95             |
| C. Careless spraymen            | 7   | 10.3                                      | 71            | 0.59              | 39             | 4.3        | 171            |

parathion a day.<sup>10</sup> These favorable levels indicating safe pesticide handling were in marked contrast to the group of careless sprayers. Here, the group handling only 10.3 lbs. of 100% parathion daily exhibited a 71% absenteeism rate and had average erythrocyte ChE levels of 0.59  $\Delta$ pH/hr. (Michel) and a mean PNP level of 4 ppm. It has been our experience that weekly averages of PNP between 4 and 5 ppm. are indicative of excessive parathion exposure and such concentrations are usually the hallmark of a careless sprayman. For example, one worker presented average concentrations for a 5-day work period during five weeks of 3.5 ppm., 2.5 ppm., 2.4 ppm., 3.6 ppm. and 2.8 ppm. - a 50% decline of this erythrocyte ChE was noted and drew attention to a large tear in his glove. With this defect removed, subsequent weekly testing were associated with a satisfactory restoration of the ChE levels and a weekly average of urinary PNP of 0.7 ppm. and 0.6 ppm., although handling the same amount of materials.

Figures 4 and 5 illustrate the potential of the laboratory surveillance of aircraft applicators and swampers. Figure 4 illustrates the RBC ChE levels and blood parathion levels of the pilots during a three-day exposure period to parathion being aerially applied. The interrupted lines on the top of the figure are the RBC ChE levels and the continuous lines on the bottom are the blood parathion levels. Although from time to time, trace amounts of parathion were detected in the blood, no serious ChE inhibition was demonstrable, neither were any of the pilots symptomatic. If these findings are compared with Figure 5, which are the similar data for the four swampers, parathionemia will also be noted but with higher concentration than in the pilots. Levels of 15 ppb. of parathion were seen at times; but in spite of this, three of the swampers were asymptomatic and showed little evidence of serious ChE inhibition. Swamper #4, however, was of special interest. Unbeknown to us at that time, he had been sick a week before complaining of nausea, vomiting and diarrhea; he had received 2 mgms. of atropine from his family physician. At the time his first blood was drawn (9:00 a.m.) we were unaware that he already had significant cholinesterase inhibition (Figure 6). Fifteen minutes after his blood test, the hose used for filling the spray tank in the helicopter burst spilling a 6-3 mixture of ethyl and methyl parathion over his legs and soaking his trousers, socks and shoes. He washed his arms with water and continued working. He returned at 3 p.m. for his second blood test, which is shown on the figure, making no mention of the spillage. At 5 p.m. he arrived home, changed his clothes, laid down as he had no appetite and was feeling weak. He became nauseated, vomited and was taken to the local hospital. Although he had muscle twitching and complained of blurring of vision, he was given symptomatic treatment only and was sent home where he remained for the next two days. His weakness cleared up and his only complaint was that of diarrhea. This figure shows the urinary PNP, cholinesterase levels and blood parathion levels observed during this incident. With an RBC ChE of 0.2  $\Delta$ pH/hr. (Michel) symptoms of intoxication developed with blood parathion levels of 22 ppb. It should be emphasized that neither his spillage nor his previous illness was known to us at the time, the worker being fearful that he would lose his job if he reported these experiences—neither were the laboratory results readily available, for we



# R.B.C. CHOLINESTERASE ( $\Delta$ ph/hr) AND BLOOD ETHYL PARATHION (ppb) CHANGES IN PILOTS IN A 3 DAY EXPOSURE STUDY.

DADE COUNTY, FLA., 1970.

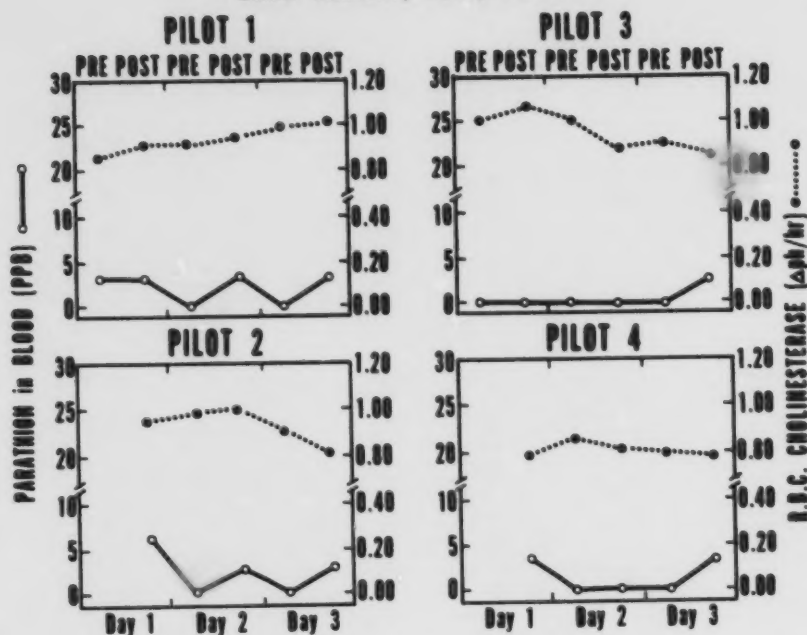


Figure 4.

were 120 miles away from the laboratory. Not surprisingly the belated administration of 2-PAM had no effect on his RBC ChE and it was the temporary removal from further exposure which ultimately restored his cholinesterase to normal.

## Incidental Exposure

This exposure is ubiquitous and leads to trace amounts of exogenous chemicals in the tissues of modern man. The only unequivocal known effect of long-term incidental exposure to persistent pesticides is the acquisition of a human tissue residue.

With improved analytical techniques, the chemical spectrum of this residue profile is growing. In most areas of the world DDT and its metabolites, dieldrin, heptachlor epoxide, BHC and its isomers, can be detected. Recently, oxychlorodane has been found in 77% of the fats analyzed, occurring in average concentrations of 0.14 ppm.<sup>11</sup> In addition, polychlorinated biphenyls are now being found with increasing frequency in surveys in the United States and recent reports from Human Monitoring Studies indicate that 30% of adipose samples exhibited these traces with 26% having concentrations which are greater than 1 ppm.<sup>11</sup>

Biodegradable pesticides as well as organochlorine pesticides are now being detected in the general population and Shafik et al. have published methods for detecting alkyl phosphates in human blood and urine.<sup>12</sup> These metabolites are more sensitive indications of incidental organophosphate exposure than are cholinesterase measurements and the method can identify these metabolites in blood and urine in concentrations which are 1/100 or 1/1000 lower than the LD<sub>50</sub> of the pesticide. More recently still, analytical chemical procedures have now made possible the study of urinary phenolic and aniline derivatives<sup>11</sup> and have widespread the feasibility of measuring the human pesticide exposure index (PEI) by quantitating these urinary metabolites.



**R.B.C. CHOLINESTERASE ( $\Delta$ ph/hr) AND BLOOD ETHYL PARATHION (ppb)  
CHANGES IN SWAMPERS IN A 3 DAY EXPOSURE STUDY.**

**DADE COUNTY, FLA., 1970.**

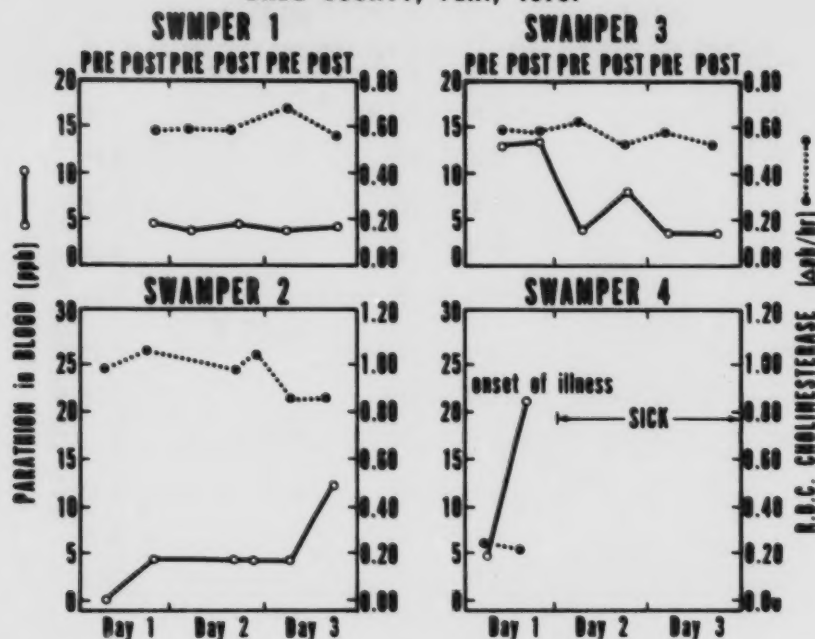


Figure 5

The detection of pesticide residues in blood and urine rather than in adipose tissue, has prompted the study of larger samples and with greater representativeness due to stratification. Both adipose and serum data of organochlorine pesticide residues have been used as expression of national prevalences of incidental human exposure and the data have permitted international comparisons. Surveys have also been used as expressions of secular trends of incidental human pollution and prevalences have been compared in chronic diseases with matched healthy controls.

As the data from these larger surveys become available, demographic and geographical frequency distributions have become apparent which clearly demonstrate that with DDT at least, and contrary to earlier beliefs, incidental pesticide exposure is not homogenous throughout the general population. The epidemiological investigation of these distribution differences facilitates the quantitation of the several environmental sources which are contributory to the incidental human pesticide exposure from this chemical.

#### **Demographic Variations of the Human DDT Residue**

Apart from occupation, age, race and social class are important descriptive demographic variables which influence the frequency distribution of the human DDT residue. In these earlier general population surveys which included residues from a sizeable number of younger persons, there was the suggestion that DDT residues but not dieldrin, were lower in the younger age group.<sup>13</sup> Table 2 illustrates adipose residue data of DDT and dieldrin from three published reports showing this trend. Figures 7 and 8 show the age association of serum total DDT residues in seven general population subgroups in Dade County. The first correlation illustrates the age dependency of these serum metabolites within the first two decades of life and the second correlation (Figure 8) shows the age trends in the older age groups. In all but one population, the relationship is much stronger with the first two decades of life than it is in the over

# COMPARISON OF BLOOD PARATHION URINARY PARANITROPHENOL AND R.B.C. CHE LEVELS WITH ONSET OF PARATHION INTOXICATION

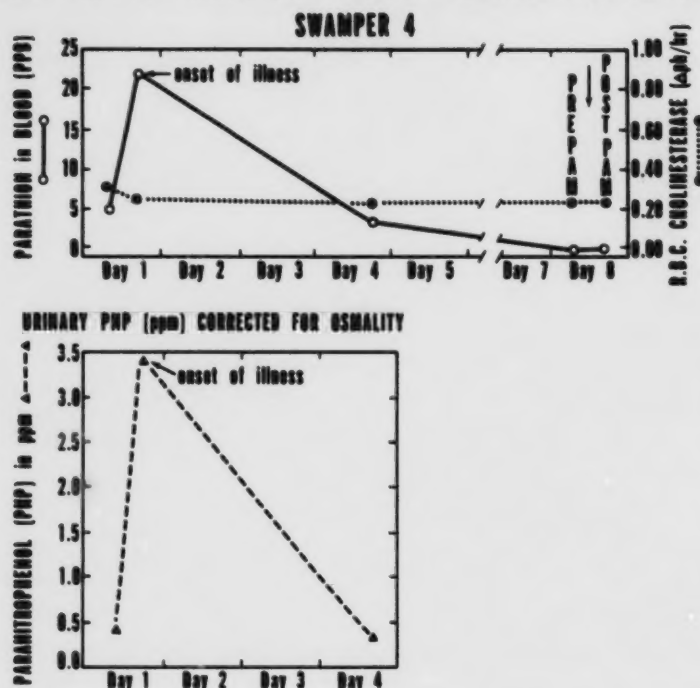


Figure 6

20-year age group. Theoretically, there are three possible explanations of these age trends which are most significant in the first twenty years of life. The first is that this is a cohort effect and that incidental human DDT exposure is less in the present 0-10 age group than it was 10 years ago for the cohort which is now in the 10-20-year age bracket. This explanation would suggest that incidental exposure is decreasing. The next possibility is that this is a host characteristic and one which is, in some way or other, connected with the characteristic of growth and adolescence. The third possibility is that since 20 years is the approximate DDT age of our society, the greater age association of DDT residues in this period of life is really a reflection of the DDT age of society and that if present use patterns continue, subsequent age groups will continue to increase with the duration of DDT exposure. Whichever of these explanations is correct, the age trends call for a reappraisal of the earlier interpretation of the secular trends of incidental human DDT exposure, and the association emphasizes the need for ongoing human monitoring studies if we wish to monitor man's incidental exposure to this and other persistent environmental pollutants.

Figure 9 shows the effects of race. This figure depicts the average adipose levels by age and race of total DDT residues of the general population of 23 states in the U.S. in 1968. The data are from the National Human Monitoring Program but also include the residue levels from the Florida Community Pesticide Studies. In common with most other surveys, blacks have greater levels of DDT residues than do whites. These race associated differences might reflect genetic or socio-economic differences or both. We have explored the role of social class in a serological survey of 800 people in Dade County. A stepwise increase of serum DDT, DDE and total DDT levels was noted in each of the Social Classes and in each of the races. Social Classes I & II, the most affluent, were significantly lower than Social Classes IV & V, the more impoverished members of the community. The same trend was seen whether social forces were measured by the Hollingshead Index, the median income of the census tract of the participants or the population

**TABLE II**  
**EFFECTS OF AGE ON TOTAL DDT RESIDUES IN ADIPOSE TISSUE**

| Country                                              | Age<br>(Yrs.) | No. | Race       | DDE  | x (ppm)<br>Total DDT | Dieldrin |
|------------------------------------------------------|---------------|-----|------------|------|----------------------|----------|
| Israel (Wasserman,<br>M. et al, 1967)                | 0 - 9         | 71  | No         | 5.6  | 10.2                 |          |
|                                                      | 10 - 89       | 133 | Difference | 9.9  | 18.1                 |          |
| Florida (U.S.A.)<br>(Davies, J.E. et<br>al, 1968)    | 0 - 5         | 17  | White      | 2.8  | 5.5                  |          |
|                                                      | 6+            | 90  | "          | 5.5  | 8.4                  |          |
|                                                      | 0 - 5         | 17  | Negro      | 4.1  | 7.9                  |          |
|                                                      | 6+            | 35  | "          | 10.8 | 16.7                 |          |
| Florida (U.S.A.)<br>(Edmundson, W.F.<br>et al, 1968) | 0 - 5         | 14  | White      |      |                      | .23      |
|                                                      | 6+            | 88  | "          |      |                      | .23      |
|                                                      | 0 - 5         | 15  | Negro      |      |                      | .21      |
|                                                      | 6+            | 29  | "          |      |                      | .20      |

of their domicile, with higher residues being found in the economically deprived and overcrowded areas of our community. I do not know whether this finding is peculiar to a warm climate. Not only have higher residues been found in these geographic areas, but even within families, a tendency to clustering of residues by families has been observed.<sup>13</sup>

#### **Geographic Variations of the Human DDT Residue**

Figures 10 and 11 show the average adipose residues of the United States and Europe surveys. In America, total residues of DDT are twice as high in the warmer states than they are in the cooler states. The same association of residues in countries having higher mean monthly temperatures is suggested from the geographical distribution of residues in Europe.

These several demographic and geographic frequency distributions of DDT do not totally support the concept that 90% of incidental human DDT exposure comes from food.<sup>14</sup> The geographical distributions of the human DDT residue, the Social Class distributions noted in our semi-tropical climate in Dade County, and the clustering of residues by families are all distribution characteristics which strongly suggest that in warmer climates, the non-dietary sources of DDT are an important mechanism of incidental exposure to this pesticide. It is our belief that house dust, reflective of individual domestic pest control practices, is the chief source of this non-dietary exposure and Dr. Aldrich's findings of significant association of house dust levels of DDT with the serum levels of this pesticide and its metabolite support the concept. Although non-dietary sources of DDT are of importance in warmer climates, the dominant role of food is certainly true in the cooler areas of the world. Furthermore, the global distribution characteristics of dieldrin entirely support the concept that food is the major source of incidental exposure to this pesticide.

The logical conclusion of this hypothesis is that on a global basis, we are still only partly monitoring man's intake of this pesticide, and if we wish to be totally cognizant of national prevalences and secular trends of this type of human exposure, we must monitor man himself as well as his food. This is what I believe should be the role of the laboratory in incidental human pesticide exposure.

#### **Conclusion - The Future and the Potential of Pesticide Protection Teams**

In this brief review of human pesticide exposure, I have tried to convey the impression that the measurements of all aspects of pesticide exposure is no simple task. The role of the laboratory in the diagnosis of acute poisoning, in the surveillance of the exposed worker and in the monitoring of society, is critical. The information provided by this resource is of the utmost importance as the profile of agricultural chemicals changes. Especially important are the

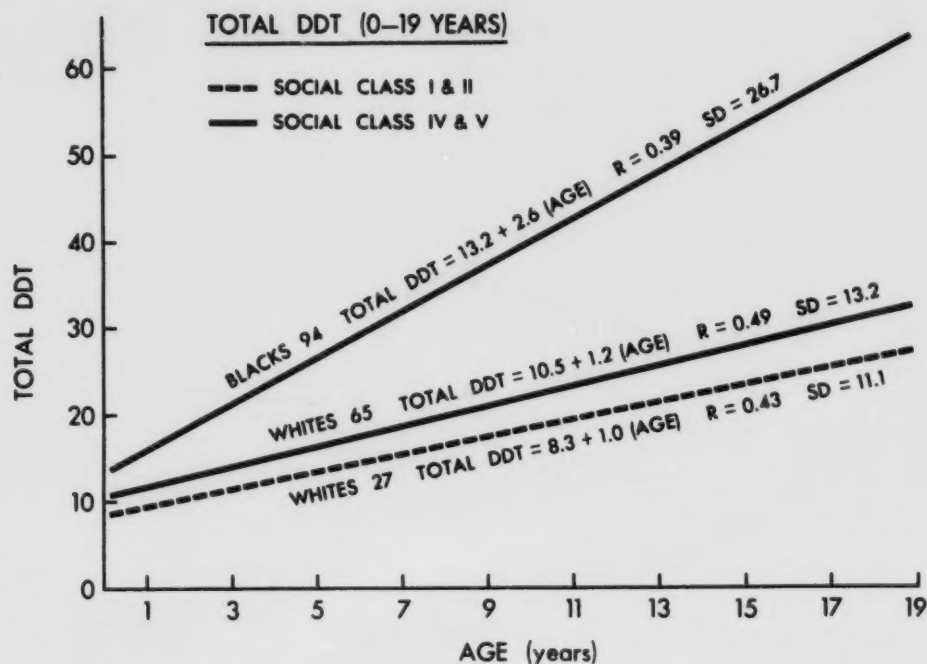


Figure 7 - Correlation of serum Total DDT levels (ppb.) in the general population of Dade County. 1971.

consequences of these changes in the developing countries where communication is slow, pesticide experience sub-optimal and largely confined to DDT experience, and where the availability of diagnostic and therapeutic assistance is minimal.

Is it not the time to bring the numerous skills and talents of these two disciplines together and is not the laboratory the catalyst which can effect this union? There is a need for a network of multidisciplinary team of experts, who, having as their goal, safe pesticide management, and working together under one roof, would provide a holistic approach to pest management. The duties of these protection teams would include: 1) the protection of humans through the investigation of individual and epidemic poisonings, 2) worker surveillance, 3) field, factory and warehouse surveillance, 4) food residue surveillance and plant protection and 5) human monitoring surveillance, forming the nuclei of a resource which could be brought into future global monitoring programs.

Such a team, with proper training and direction would form a resource which could answer the concerns for man and his environment and ensure food production with the simultaneous protection of man and his environment.

#### Summary

In summarizing, therefore, human pesticide exposure can be conveniently classified with three types of exposures—acute, occupational and incidental exposures. Over the passage of time, this separation is not precise, the

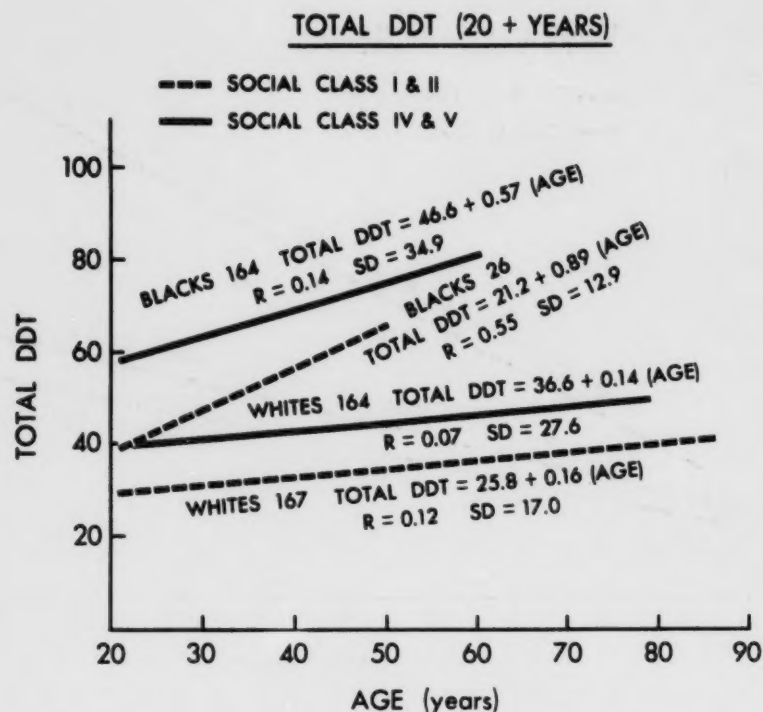


Figure 8 - Correlation of serum Total DDT levels (ppb.) with age (20-80+ years) in the general population of Dade County. 1971.

pesticide worker in reality passes through a continuum of these three types of exposure. A human pesticide exposure index can best be obtained by laboratory measurements of exposure, and in acute exposures, the function of the laboratory is diagnostic, whereas in occupational exposure the laboratory fulfills the needs of surveillance and monitoring respectively.

If we are, in the future, to meet the growing problem of human pesticide exposures, especially in the developing countries, a holistic approach to Pest and Pesticide management is needed. It is suggested that by intergrating the skills of agriculture and health through the organization of multidisciplinary Pesticide Protection Teams, increased food production can be assured with simultaneous protection of man and his environment.



**$\bar{X}$  ADIPOSE LEVELS BY AGE AND RACE OF TOTAL DDT (ppm) IN  
GENERAL POPULATION FROM 23 STATES OF U.S.A., 1968.**

(HUMAN MONITORING & FLORIDA DATA)

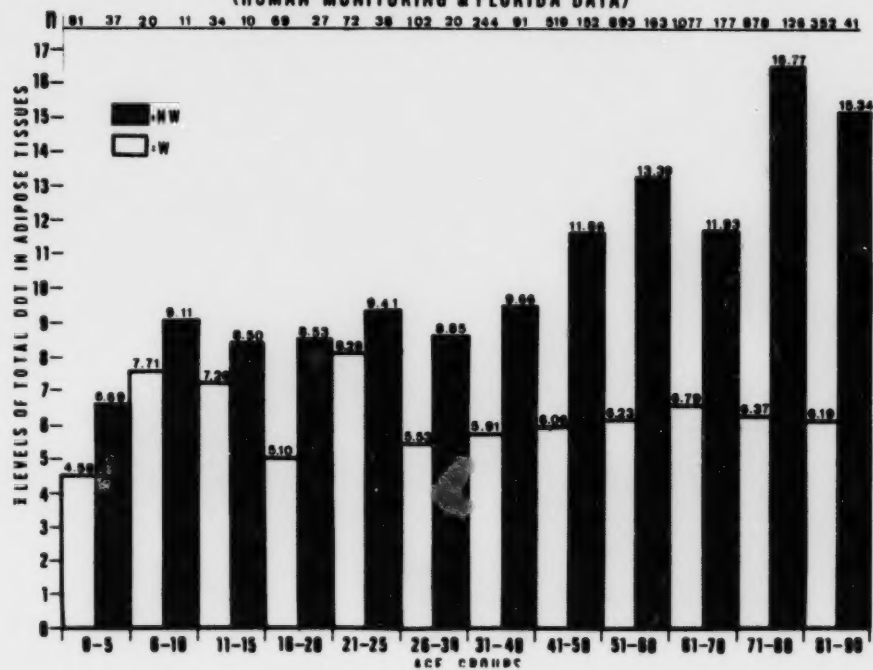
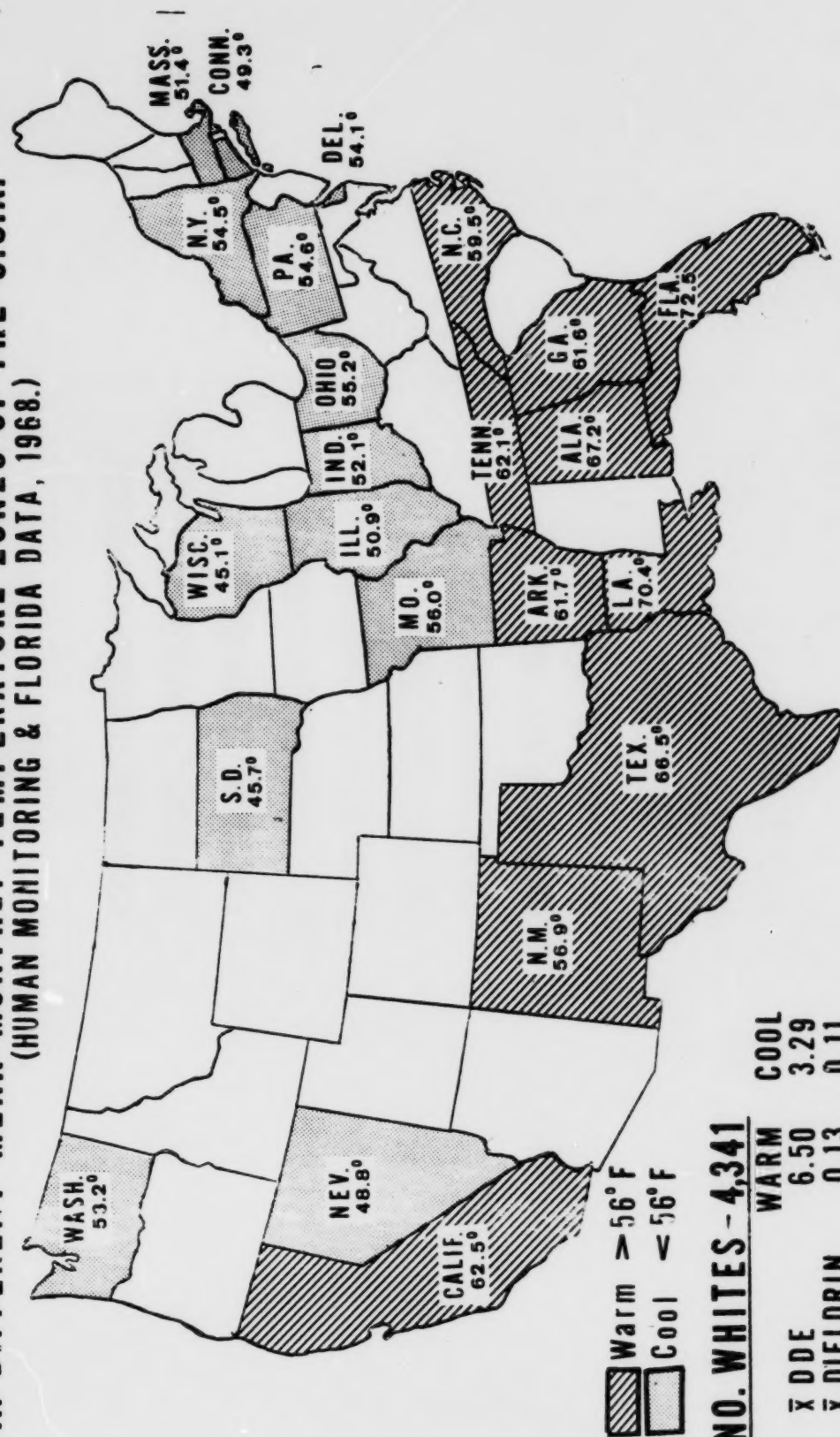


Figure 9

# **GEOGRAPHICAL COMPARISONS OF HUMAN ADIPOSE PESTICIDE RESIDUES (ppm) IN DIFFERENT MEAN MONTHLY TEMPERATURE ZONES OF THE U.S.A.**

(HUMAN MONITORING & FLORIDA DATA, 1968.)



## **NO. WHITES - 4,341**

|                     | WARM | COOL |
|---------------------|------|------|
| $\bar{x}$ DDE       | 6.50 | 3.29 |
| $\bar{x}$ DIELDRIN  | 0.13 | 0.11 |
| $\bar{x}$ TOTAL DDT | 9.15 | 4.84 |

## **NO. NEGROES - 893**

|                     | WARM  | COOL |
|---------------------|-------|------|
| $\bar{x}$ DDE       | 9.66  | 5.26 |
| $\bar{x}$ DIELDRIN  | 0.13  | 0.14 |
| $\bar{x}$ TOTAL DDT | 14.33 | 7.86 |

Figure 10

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Figure 11- Concentrations (in ppm) of DDT-type compound and HEOD in adipose tissue in Europe; concentrations of HEOD in italics.

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## PROTECTION OF INDIVIDUALS WHO MIX OR APPLY PESTICIDES IN THE FIELD

by

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Workers who mix or apply pesticides in the field are often exposed to relatively high levels of such compounds. Illnesses do occur as a result of overexposure, however, most are a result of carelessness or accident. Experience has shown that if the various routes of entry of pesticides into the body are protected, even the more toxic compounds can be used safely.

There are four routes of entry: (1) dermal, (2) respiratory, (3) oral, and (4) through cuts or abrasions in the skin. Protection of these routes prevents exposure and prevention of exposure is good insurance against poisoning.

**Dermal Route:** This route is probably the most important route of entry into the body during most exposure situations in the field, especially where liquid sprays are involved. The dermal route has probably been responsible for many poisonings of workers, especially from the more toxic organophosphorus compounds.

In research studies at our laboratory we have measured the potential exposure of several hundred pesticide applicators, and the results indicate that over 97% of the pesticide to which the body is subjected during most exposure situations, and especially to applicators of liquid sprays, is deposited on the skin. It should be understood that any given amount of pesticide is more rapidly and more completely absorbed by the oral or respiratory routes. However, absorption of pesticides by these two routes is probably too small a fraction of the total potential exposure to be considered the main factor in most poisoning cases of workers in the field.

In one set of experiments, for example, we have calculated the potential dermal exposure of orchard spraymen to parathion to be approximately 19 mg/hr; however, the potential respiratory exposure was calculated to be only 0.02 mg/hr of exposure.<sup>1</sup> This indicates that there is potentially 950 times more dermal exposure than respiratory exposure to workers in that type of application operation. Thus, if only a small fraction of the potential dermal exposure was to be completely absorbed it would probably still be more than the respiratory exposure. The respiratory route, however, takes on increased importance when exposure is to vapors, fine dusts, fogs, or aerosols made up of very small droplets.

The importance of protecting specific body areas has not been clearly defined in the past due to the difficulty in accurately measuring the degree of absorption of different compounds through human skin. The most useful and probably most accurate estimations or measurements on the percutaneous penetration of pesticides in man which have been accomplished thus far have been made by Maibach and co-workers.<sup>2</sup> Using radioactive labeled pesticides they were able to determine approximately what fraction of an applied dose would be absorbed through the skin. In this way they not only compared the degree of dermal absorption for certain pesticides but also compared absorption of a single pesticide for different parts of the human body. The results obtained indicate that sufficient importance may not have been attached to protection of certain body areas.

In checking dermal penetration of parathion at different body areas these researchers found that the area of greatest absorption on man is the scrotum where approximately 100% of an applied dose was absorbed. The possibility of pesticide on this body area being completely absorbed is a very important point and emphasizes the need for increased concern about protection of the area. Of utmost importance would be the need for extreme caution in order to avoid spillage of highly toxic liquid pesticide onto the scrotum.

Although cloth overalls or trousers provide a reasonable amount of protection where contamination does not easily penetrate clothing, the wearing of waterproof trousers provides the best protection for the lower trunk and leg areas and is especially recommended in work situations where there is chance of liquid spillage, soaking by continued contact with more dilute liquid sprays, or penetration of clothing through excessive contact with dry pesticides. Even though regular clothing is covered by waterproof protective gear, it is important that the worker change to freshly laundered clothing each day in order to prevent contamination of the scrotum or other skin areas. Needless to say, use of clean clothing and daily bathing in an effort to avoid excess dermal absorption are essential in any type of exposure situation.



Protection of the upper trunk and arms from contamination by toxic pesticides is important, especially under conditions where heavy spray drift may thoroughly wet cloth shirts, coveralls, and underclothing or where concentrated dry pesticides come in contact with clothing and skin. Our studies have shown that the greatest potential contamination of spraymen in this general body area is the upper back, shoulders, and forearms of workers operating equipment which propels spray up into the air where it is more subject to drift. Under these conditions a waterproof jacket or raincoat provides the best protection for this general body area. This gear is usually worn during cooler conditions, but as the temperature rises and the clothing becomes unbearably hot to wear, workers tend to discard them and work with much less protection—perhaps only a short-sleeved T-shirt-type undershirt on the upper trunk area. Under such conditions workers should be encouraged to at least wear a long-sleeved cloth jacket that will not be easily penetrated by pesticide, and preferably one that can be properly washed.

The wearing of long-sleeved heavy grade "GI" cotton shirts or coveralls as outer clothing during hot weather, often with no underclothing, is popular with many applicators even though this is not a recommended practice. Fortunately, these items of outer clothing provide a reasonable amount of protection where spray drift is light with very fine droplets that do not wet through to the skin. Under such conditions the clothing should be changed and laundered daily. If clothing used during spraying such as shirts, jackets, or coveralls are merely hung up to dry after work and used repeatedly, as is often the practice, it doesn't take long for the pesticide material to work through where it will make contact with underclothes or skin.

In selecting protective clothing for workers it is important to take into consideration the comfort of the individual when he wears such items. The conventional black or dark green rubberized or plastic waterproof jackets in common use during past years are considered by many applicators to be uncomfortable to wear not only because of greater heat absorption but also because they may be of heavy grade material and not very flexible. During recent years, however, several jackets and jacket-trouser combinations that are lighter in color and weight have been available. Although less durable, they are less costly to replace. Nevertheless, there is still considerable discomfort in wearing any waterproof clothing during hot weather because of trapping of body heat.

Disposable paper jackets have been tested and found suitable for use only under conditions where heavy wetting does not occur. Such paper jackets were found to be much cooler and thus more comfortable than other jackets tested.

Observations of pesticide applicators have indicated that although waterproof clothing items, and especially jackets, are usually carried by the worker, or readily available to him, he usually will not don the clothing until drift of pesticide increases to the point where he feels protection is necessary. Unfortunately, by this time there is often considerable contamination of skin and clothing. The covering of contaminated skin areas by waterproof clothing may create conditions under which dermal absorption may be increased. This may be more important during hot weather where high temperatures and perspiration are involved. Whether or not there would be less absorption under these conditions than if the clothing were left off entirely depends upon the potential exposure which might occur after the worker puts on the clothing. Although the increase of absorption of pesticide by covering contaminated skin with various items of protective clothing is not known, it is important to emphasize the need to put on protective gear *before* the skin has been contaminated to any great degree.

Results of the dermal absorption studies noted above indicate that the head-neck area should be given more attention. In this area absorption of parathion was found to be from 32% to 47% of an applied dose,<sup>2</sup> much more than we would have anticipated and more than at other areas of the body studied with the exception of the armpit and scrotum. When observing pesticide applicators it is easy to conclude that the face-neck area is less protected than most other parts of the body.

Protection from downward drift is especially important during application of liquid sprays. The headgear most commonly used by pesticide applicators is the billed cap which provides some protection for the face but very little for the remainder of the head-neck area other than the scalp. The conventional "Sou'wester" rain hat, often used when heavy downward drift occurs, does not provide exceptionally good protection for the face and sides of the neck. This is because of the narrow brim in all areas except at the back of the neck. Metal or fiber "hard hats" are also used to some extent; however, most have too narrow a brim to provide adequate protection. "Hard hats" which allow circulation of air over the head under the hat should not be used where exposure is to toxic dusts.

Our studies have shown that the greatest protection from downward drift of pesticides is afforded by some type of wide-brimmed hat, preferably made of water-repellent material. Waterproof hats, other than the "Sou'wester," were not readily available at that time. However, one is now available which is waterproof and also has a wide brim that affords good protection of the face-neck area. This type of hat should be recommended for use by all applicators who may be subjected to downward drift of pesticides.

Of particular interest in relation to exposure of the head-neck area is the finding by Maibach *et al.*<sup>2</sup> that absorption of parathion is relatively efficient (47% of applied dose) in the ear canal. Exposure in this area could occur through drift of fine pesticide mists or dusts or by digging in the ear with the tip of a contaminated finger.

It is of importance to note that wearing goggles and respirators provides considerable protection to the face.

Although a statement suggesting the use of goggles can be found on certain pesticide labels, they are rarely worn except by pilots who apply pesticides by aircraft. Questioning of pilots has revealed that they wear goggles not only to prevent poisoning and to keep wind out of the eyes but also to prevent certain organophosphorus pesticides that are direct inhibitors of cholinesterase from causing moiosis. This is understandable because it has been shown that unilateral contamination of the eye with TEPP may cause pilots to inadequately judge distance.<sup>3</sup> The incoordination which may accompany this could be a serious threat to safety.

The hands are often the body area having the highest exposure to pesticides and they have a greater chance of coming in contact with the more concentrate formulations. They are also more subject to cuts or abrasions, which will be discussed later. High potential exposure to the hands brings attention to the need for wearing gloves. Some people who have worked with pesticides feel it is better not to wear gloves than to wear gloves that are contaminated on the inside; something which invariably occurs to some degree. Our research concerning the use of protective gloves indicates that, unless there is gross contamination of the inside of the gloves, the potential exposure is less when wearing gloves than when not wearing them. If gloves are kept clean on the inside there is very little doubt concerning the value of their use when handling pesticides. Unlined rubber gauntlet gloves provide the best protection because the gauntlet covers the wrist area not normally covered by the jacket sleeve and they can be turned wrong side out for proper cleansing of the unlined inside surface.

In order to provide proper protection to the feet, waterproof shoes or boots should be worn when handling or applying pesticides on a large scale. When leather shoes become wet with spray material they have a tendency to become cracked and dried out to the extent that pesticide easily penetrates through to the sock or foot. Both leather and canvas shoes absorb chemicals and may hold them in contact with the wearer. Boots should be washed and dried thoroughly, inside and out, as frequently as needed to remove any pesticide contaminant.

**Entry Through Cuts or Abrasions:** Any break in the skin may allow a more direct route of entry into the blood stream. Even if the outer layer of dead cells (stratum corneum) of the skin is removed by scratching or scuffing the result may be a potential for increased absorption at that site as this layer of cells is considered the main barrier against chemicals. This route of entry is one that may not have received enough attention in the past. Cuts and abrasions occur most frequently on the hands, and unfortunately, the hands are the body area most often in contact with the more concentrate forms of pesticides. There have been poisoning cases suspected as having been a result of entry by this route; however, there has not been enough evidence to definitely prove that this route played the major part in the illnesses.

One suspected poisoning case which might be used as an example involved a 25-year-old worker in a pesticide plant whose finger was crushed by a fork lift which appeared to be contaminated with concentrate parathion.<sup>4</sup> For several weeks prior to the accident he had been working primarily with carbaryl, along with a small amount of malathion, but nothing as toxic as parathion. The worker became severely ill and exhibited symptoms of poisoning within approximately 30 minutes of the accident, a coincidence which aroused suspicion that the illness was associated with the accident. Analysis of a blood sample showed cholinesterase activity to be very low. There was prompt clinical response to administration of atropine and 2-PAM. Although there does not appear to be enough evidence to prove entry of pesticide at the area of broken skin, the circumstances around the case indicate that this route of entry could possibly have played a major part in poisoning. In such case poisoning symptoms may not have developed had the worker been wearing gloves.

Another suspected case involved broken skin on the feet of a 54-year-old male who wore canvas shoes while spraying an apple orchard.<sup>5</sup> His shoes became soaked with the dilute spray from walking through a wet cover crop. He had complained of "scalded feet" indicating raw, red, oozing areas especially on his soles and between his toes. On several occasions he was aided in bandaging his feet or procuring tape, etc. by co-workers. He had sprayed for several days but on the day of his death he had sprayed for 9 hours, wearing canvas shoes all day. A post-mortem blood sample showed very low cholinesterase. The physician investigating the case indicated that cause of death was parathion poisoning due to probable dermal absorption, particularly through an area of dermatitis on both feet. Because body areas other than the feet were exposed there is no complete assurance that this was the main route of entry of the compound. Nevertheless, this case points out the importance of wearing rubber boots or shoes while applying liquid pesticides.

**Respiratory Route:** Where toxic dusts and vapors or very small spray droplets are prevalent, or where application is in confined spaces, protection of the respiratory route is especially important. Extremely fine particles and droplets found in dusts and mists are much more easily drawn into the respiratory system than the larger droplets formed by most conventional dilute spray machines. Our tests have shown that when operating an 8X (eight times the normal dilute concentration) concentrate airblast machine in fruit orchards the potential respiratory exposure is nearly 3 times greater than when operating the conventional dilute machine.<sup>1</sup>

The cartridge-type respirator provides adequate respiratory protection in most types of application situations. In certain cases it is advisable to use gas masks with special canisters because of their greater adsorbent capacity. Applicator pilots who risk the possibility of flying through drift of fine droplets or dusts should use a face mask equipped with a filter canister and attached either to their belt or to the inside of the cockpit. When fumigating or applying highly toxic pesticides in confined spaces it is advisable to use a respirator with a special compressed air supply tank so that none of the contaminated ambient air is inhaled.

If respirators are to be effective they must have proper care. The rubber face-piece becomes hardened and the head straps lose their elasticity with age and exposure to heat and sunlight. These conditions lead to poor fit and allow leakage around the face-piece. Two of the more common offenses in the care of respirators that we have observed are (1) failing to occasionally wash the face-piece with soap and water and (2) neglecting to change the filter cartridges or canisters regularly. Washing of the face-piece of a cartridge-type respirator should not be attempted while the cartridges are in place as moisture may contact the activated charcoal filter material and reduce its effectiveness in adsorption and absorption of pesticides. Solvents should not be used as a cleaner for they may damage certain parts of the respirator. The general recommendation is that cartridges should be changed after 8 hours of continuous exposure. In most application situations this leaves much up to the individual worker to keep a record of his respirator exposure time. In a formulating plant where hours of exposure are more regular this is more easily controlled under the guidance of a foreman. Under conditions of intense exposure the useful life of the cartridge is much shorter. Thus, if the breathing seems hampered, or if the odor of pesticide is detected, the filter cartridges should be changed immediately. If the outer filter pads are separate removable units they should be changed more frequently than the cartridges.

During discussions of the respiratory route of entry into the body the question is often raised concerning the hazard of smoking pesticide-contaminated cigarettes. We have found it difficult to measure such potential exposure with any great degree of accuracy. The technique we have utilized thus far involves subjecting the cigarettes to normal handling through the process of removing them from the pack and placing them in the mouth, lighting them, and smoking one-half the cigarette. The remainder of the cigarette is then analyzed for pesticide content. The values obtained are based on the assumption that pesticide on the cigarette will be volatilized before being broken down by burning and that none of the volatile or particulate pesticide would be trapped in the butt end of the cigarette. In observing smoking by workers it was noted that the area of greatest contamination of the cigarette was far enough from the butt end to allow burning of the contaminated area in most cases.

In studies of cigarette contamination by spraymen applying endrin in orchards, the potential exposure through smoking during application operations was calculated to be not more than 0.002 mg per cigarette, even when the cigarettes were handled with hands wet with the dilute spray.<sup>6</sup> In later studies<sup>7</sup> involving spraymen applying parathion to apple orchards by airblast machines, from 0.003 to 0.005 mg of parathion per cigarette could be recovered where they were handled with hands that were contaminated but dry. When handled with hands that were wet enough with dilute spray to leave moist spots on the cigarette paper from 0.020 to 0.050 mg could be found. In a controlled study designed to determine what might be the maximum contamination of cigarettes through such handling, hands were dipped in 45% emulsifiable concentrate parathion, the hands wiped off lightly on the trousers, and the cigarettes were handled to simulate smoking. The highest value found was 0.235 mg per cigarette.

Even though values for potential respiratory exposure through smoking contaminated cigarettes may not appear to reflect any great hazard, two important points must be kept in mind: (1) Pesticide entering by the respiratory route is practically 100% absorbed, and (2) There is no assurance that a more toxic breakdown product will not be formed and inhaled as the high temperature of a burning cigarette reaches the contaminated areas rather than complete destruction of the compound by burning. For example, in the case of parathion the oxidation product, paraoxon, is estimated to be much more toxic than the parent compound, possibly 100 to 500 times more toxic. This could be an important factor as far as hazard is concerned and emphasizes the need for recommending washing of hands and face before smoking.



**Oral Route:** Oral exposure is difficult to measure. We are studying techniques at the present time. Analysis of saliva samples of exposed individuals appears to give some indication of contamination. Splashing of liquid concentrate into the mouth while pouring and measuring pesticides may produce the most serious oral exposure. Contamination may also occur through licking the lips, by rubbing the mouth with contaminated arms or hands, by careless actions such as attempting to blow out clogged spray nozzles with the mouth, or by eating or drinking with contaminated hands.

We have attempted to measure the parathion contamination of typical sack lunch items, such as sandwiches, cookies, and pickles by workers whose hands had been contaminated while thinning fruit in recently sprayed apple orchards.<sup>8</sup> A lunch consisting of four half-sandwiches, two cookies, and one pickle was given to workers who handled and ate one-half of each item with unwashed hands. The other half of each item was analyzed for parathion. This provided potential oral exposure values for lunch items. A total of approximately 0.103 mg of parathion was found on the typical lunch mentioned above. Although this is not a great amount of pesticide, it would add to the total exposure of each individual; thus, workers should wash hands and face before eating.

**Discussion:** Workers who handle pesticide compounds must realize that there is some element of risk involved. Accidents do occur, even among workers who are careful. In case of accidental gross contamination of skin with a highly toxic compound every effort must be made to cleanse the contaminated area as quickly and as thoroughly as possible. The best recommendation at present is the use of plenty of soap and water. Wash by rubbing with the hands or with a piece of cloth. Do not scrub with a brush because the outer protective layer of the skin may be abraded enough to allow more rapid absorption of any pesticide not removed. A bar of soap, towel, and container of water should be carried on every pesticide application machine or accompanying vehicle for use in washing should a spillage occur. If pesticide gets in the eyes they should be thoroughly flushed with water for at least five minutes. If a person should feel ill while working with pesticides he should stop work at once and get medical attention. If his illness is diagnosed as being caused by a pesticide he should not return to work until a physician advises that it is safe to do so.

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**PERCUTANEOUS PENETRATION OF PESTICIDES  
THROUGH HUMAN SKIN**

by

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Paper not received. Interested persons are referred to:

1. Regional Variation in Percutaneous Penetration in Man, Archives of Environmental Health, Vol. 23, September 1971
2. Percutaneous penetration of pesticides in man - A preliminary report, Pesticide Publication No. 486, Environmental Protection Agency, Chamblee, Georgia 30341

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## SPECIAL PANEL ON PROTECTIVE CLOTHING, GOGGLES, GLOVES AND FOOT COVERINGS – THEIR VALUE DURING HANDLING AND USE OF PESTICIDES

by

*W.V. Andresen (Leader)  
Director, Industrial Hygiene  
and Safety, American Cyanamid  
Company, Wayne, New Jersey*

The American Cyanamid Company introduced the first organophosphate pesticide (parathion) into this country in 1946. We no longer manufacture parathion, but we do make and market a number of organic phosphate insecticides which range from mild to high toxicity by way of ingestion, inhalation and absorption through the intact skin.

From the very start of manufacture, a multifaceted program of control was instituted for the protection of our workers against the effects of organophosphates. We think it is a good program, as evidenced by no serious illness over the last 25 years. The same program was recommended in part or toto for formulators, pesticide applicators and the small user such as the farmer through labels, various publications, participation in meetings on local and countrywide scales.

We still use the same program in our manufacturing plants and require that our custom blenders do likewise. The program is as follows:

1. Education of the employee on the hazards of the operation.
2. Minimization of the potential exposure of the employee to the insecticide by engineering means, such as closed equipment, mechanical exhaust ventilation, etc.
3. Periodic inspections are made, such as ventilation checks, and preventive maintenance is practiced to insure maximum safety. Clothing regulations are adhered to and atmospheric sampling is required.
4. Provision of protective clothing to the employee – the wearing of the clothing is mandatory. Freshly laundered cotton clothing (socks, underwear, long-sleeved coveralls or long-sleeved shirt and pants, cap and outer jacket) is provided. These are collected at the end of the day and laundered before reuse. The employee enters and leaves the plant in his own clothing. If clothing becomes contaminated during the day, it is changed and a shower is taken immediately. Each employee is provided with rubber booties and rubber gloves. The gloves are changed frequently, and the boots are decontaminated each day. Each employee has a respirator approved for protection against organophosphates, which he uses on particular operations. Filters and cartridges are changed frequently. The respirators are cleaned and sanitized each day. Splash-proof goggles and face shield are provided and required where there is a chance of face and eye exposure, such as opening valves, drumming liquid products, etc.
5. There is a mandatory personal hygiene program. No food or tobacco is allowed on the person or in the working area. Employees are instructed to wash before eating, smoking or going to the bathroom. A shower is required at the end of the work day and is supervised. Employees are provided with separate lockers for clean and for work clothing, with the shower between these facilities.
6. Good housekeeping is maintained. Spills are removed immediately. Waste material is disposed of by accepted methods.
7. Periodic blood tests are performed on employees as a check on the efficiency of the control program. If the tests show lowered levels, the operator is transferred to a different job, where there is no exposure.
8. Public hazard control - we have an emergency telephone (201-835-3100), manned 24 hours a day. This number is printed on bills of lading and labels and in publications provided to physicians and fire departments where our products are formulated, warehoused and used. A call will obtain immediate advice and, if warranted, assistance on the problem in hours.

In the manufacture of our technical product, skin contact is the major hazard; and, therefore, the provision of protective clothing and equipment and the personal hygiene requirements are most important.

In formulating dusts or granules, inhalation of the pesticide is a significant hazard; and the use of ventilation is important, as is respirator protective equipment.

In application, there are both potential skin contact and inhalation hazards; and protective clothing and equipment are most important. In all phases of the utilization of pesticides, good personal hygiene is a must and should be stressed.

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*C.R.E. Merkle  
Mine Safety Appliances Co.  
Pittsburgh, Pennsylvania*

Protection from pesticides requires consideration of all three modes of entry into the body:

1. The gastro-intestinal tract
2. The skin
3. The lungs

To avoid oral ingestion through the GI tract one must practice good habits of personal hygiene, including the avoidance of smoking, eating and chewing tobacco in a contaminated area.

Skin protection is particularly important in the case of the organo-phosphates. From a protective standpoint full impermeable clothing including head covering, gloves, and impermeable shoes should be worn. However, from a practical standpoint we must recognize man's limitations - particularly in regard to thermal burden. If permeable clothing is worn it should be of long-sleeved variety and preferably of a fairly tight weave. In any case, all clothing items should be washed daily in a strong caustic soap, particularly if the exposure has been to organo-phosphates.

In mixing pesticides and applying them by spray or fogging equipment it is particularly important to wear suitable respiratory protective devices. Respirators must be maintained in good condition and cleaned daily or oftener. Filter/cartridges should be replaced daily.

Regardless of the exposure situation much can and should be done to reduce the hazard. In manufacturing and formulating plants sound engineering control methods should be applied to eliminate and/or reduce exposure conditions. Local exhaust ventilation with applicable collector systems should be utilized for processing gaseous, liquid and solid materials. Also strict procedures relative to personal hygiene should be enforced.

In the application of pesticides much can be done to reduce exposure by starting the application downwind and avoiding the drift.

Following careful mixing and loading procedures to avoid splash and/or ambient dust is also pertinent. Ultimately, the future availability of practical air conditioned and suitably filtered tractor cabs will be most helpful in providing protection and comfort to the applicator.

William S. Colehower  
Jomac Products  
Warrington, Pa.

Protective clothing, the subject of my address should be defined, before I begin.

I will discuss and review different types of clothing manufactured and designed to protect the individual operator from *splashes* or *sprays* of dangerous liquids.

Many types of clothing are available today to protect the individual from heat, cold and other elements of nature.

Therefore, it is important that we define the capabilities of the clothing supplied to the worker, before it is called "Protective Clothing."

Manufacturers of clothing designed to protect the operator from splashes of liquid, use synthetic materials as coating compounds. Using such materials as rubber, neoprene and polyvinyl chloride, we coat or apply these synthetics to woven fabrics (usually nylon, cotton or rayon). Thus, we create a barrier for the purpose of repelling various types of liquids. The coating compound creates a barrier and prevents air from passing through the woven fabric and in warm climates, if the operator is required to wear coated clothing for a long period of time, he will probably become uncomfortable. The lighter the total weight of the fabric, the more comfortable the individual, but this does not guarantee him total comfort. Manufacturers of coated fabric have spent large sums in research, attempting to design a fabric that would breathe (allow the passage of air in both directions under normal operating conditions) and still protect the worker from harmful liquids. This chemical engineering feat has not yet been accomplished; and, therefore, our job is to present the most comfortable clothing that will offer the operator maximum protection, under the conditions and exposures of his job.

As you are now aware, the manufacturers of coated fabric and splash clothing have certain constraints in their job, even before we begin to design a safe, comfortable garment.

In working with the new plastics during the last decade, we have been able to develop materials that will not crack, peel or deteriorate through normal storage.

The most popular and available garment used by the sprayers of anhydrous ammonia in farm work is as follows.

1. The *double coated* garment consisting of a jacket and pants.
2. This garment is available with a hood and in parka style offering more protection than a normal jacket.
3. A new innovation to protection is the glove-ring adaptation, which is commercially available and offers a greater degree of worker safety and protection, especially when the operator is working with liquids under pressure. (See enclosed)
4. The open-back apron has been popular with chemical manufacturers who require the employees to wear protective clothing for longer durations.
5. Under emergency conditions head to toe coveralls made from double coated fabrics are available with air fed systems which will supply cooled air to the garment. A plant air system is required under these conditions.
6. Other types of emergency clothing offering the wearer total coverage would be a coverall that would be worn after the operator has been equipped with a 30 minute air bottle and breathing apparatus.

The total protection suit or head to toe garment is most useful when there is a large spill or a pipe or valve under pressure is required to be repaired.

Protective gloves are available in the same synthetic coatings as is splash clothing. Manufacturers of hand protection have been able to provide ever increasing flexibility and dexterity, because of increased technology in the plastics field.

A recent development of a cotton inner lining of the glove has made it feasible for us to provide the handler of toxic liquids a comfortable, washable piece of equipment, providing excellent liquid protection with a good wet grip, created by a special roughened surface on the glove.

Unsupported rubber or latex gloves give excellent dexterity and flexibility. They are available in different mill thickness depending upon the hazard and the job requirement.

Boots or rubbers should be worn while the operator is loading or unloading liquids.

Boots made from rubber or plastic should provide adequate liquid protection and insure that if a spill occurs, absorption will not occur.

The length of the boots will depend upon what type of clothing is offered to the operator. If a complete suit was provided, 12" long boots could be adequate, or if a 44" apron was supplied, knee length boots would probably be more applicable.

Most protective "Splash Clothing" and gloves are designed to be worn, washed or reconditioned and re-used. Garments and gloves can be neutralized and then water washed at temperatures not to exceed 150° and after reconditioning, returned to the job.

Our experience has been that many items will withstand exposure, abrasion and washing and can be returned to the job for re-use. Various heavy users of gloves and clothing save thousands of dollars every year by washing their protective apparel.

As manufacturers of protective clothing in the industry today continue to develop new and improved products, we feel that it is essential that protective clothing be worn when feasible, to protect the worker from harmful liquids.

**FOR GREATER PROTECTION AGAINST HARMFUL LIQUIDS**





*M. F. Shields  
Willson Products Div.  
Redding, Pennsylvania*

The eyes are another mode of pesticide entry into the human body and for this reason, they should be protected with goggles or other types of eye and face protection. In addition, certain pesticides can cause visual disturbance and damage to the optic nerves.

The labels on pesticide containers should always be studied to determine if eye protection is required. If there is doubt, consider that eye protection is necessary to prevent the possibility of eye injury.

There are several methods for providing eye protection while manufacturing, formulating, mixing and applying pesticides. These are:

1. Full facepiece respirators
2. Full facepiece gas masks
3. Hoods with windows
4. Faceshields
5. Goggles

Full facepiece respirators and gas masks provide respiratory as well as eye protection. These are supplied in either two lens or single lens models.

Means must be provided for eye correction while wearing full facepiece respirators. This can be accomplished by supporting or mounting corrective spectacles or lenses inside the facepiece using methods incorporated in facepiece by the manufacturer.

Under no circumstances should temples on corrective spectacles be allowed to break the edge seal of the facepiece and wearer's face as leaking will occur. Even the thinnest temples or an elastic headband will result in leakage. As a simple solution to wearing corrective spectacles inside the facepiece, temples can be cut off approximately two inches from the hinge and then taped to the wearer's face.

Under no circumstances should contact lenses be worn with a respirator full facepiece as a tiny particle of foreign matter may become lodged behind the contact lens resulting in extreme irritation requiring removal of the facepiece.

Hoods with windows are used on supplied air-line respirators and respirators with blowers.

Faceshields are used where splash of pesticides can occur. These are generally used in manufacturing, formulating, mixing and transfer operations.

Goggles are generally used in combination with half-mask respirators. Only goggles that comply with requirements of the American National Standard Practice for Occupational and Educational Eye and Face Protection Z87.1-1968 should be used.

The recommended type of goggle for pesticide application is described in ANSI Z87.1 as Goggle, Flexible or Cushion Fitting with Hooded Ventilation. This goggle is designed for handling chemicals and protects against splash, acid burns and fumes.

The requirements for this type of goggle are:

1. Plastic lens shall not be less than 0.050 inch in thickness.
2. Lens shall not fracture or be displaced from the frame when subjected to the impact of a 1" steel ball weighing 2.4 ozs. dropped from a height of 50 inches.
3. The lens shall not be pierced from the impact of a #25 Singer needle in a 1.56 oz. holder dropped from 50 inches.
4. Lenses shall not burn at a rate greater than 24 seconds per inch.
5. Optical quality of lenses:

Prismatic effect shall not exceed 1/16 prism diopter (3/4" distortion at 100")

Refractive power shall not exceed plus or minus 1/16 diopter.

In selecting goggles, care must be taken to assure that they will fit properly with the half-mask respirators being used. Most flexible fitting goggles will fit over corrective spectacles.

Lens fogging is a problem, especially on hot humid summer days. A new coating for plastic lenses known as hydrophilic acrylic polymer is now used by several manufacturers. This coating prevents or eliminates fogging by dissipating moisture back into the atmosphere.

It is important to keep goggles clean and in proper repair. Use a good detergent and clean goggles thoroughly. Replace scratched lenses. Disinfect goggles and store in clean, dust-proof containers.

## EFFECTIVENESS OF RESPIRATORS AND SIMILAR GEAR FOR PROTECTION AGAINST INHALING PESTICIDES

by

*C.R.E. Merkle  
Mine Safety Appliances Co.  
Pittsburgh, Pennsylvania*

A thorough knowledge of the exposure hazards, an understanding of why protection is required and complete information on the application, limitations and required care of the various respiratory devices are requisites to providing effective respiratory protection against pesticides.

In the field application of pesticides we are most concerned with exposures to spray of low vapor pressure liquids and/or solid material in the form of wettable powders or dusts. The particle size of the aerosol (solid or liquid) will determine its ability to invade the respiratory system. Particles above 10 microns in size generally are screened out by the hairs in the nose. Particles between 10 and 2 microns in size are generally trapped in the airways of the upper respiratory tract where they are moved upward to the pharynx by means of the constant "carpet sweeping" action of the hair-like "cilia." Upon reaching the pharynx, however, they can be swallowed and thus enter the body through oral ingestion. Particles generally below 5 microns in size can by-pass the collection system in the upper respiratory tract and thus invade the alveolar spaces and gain entrance into the body through the respiratory system.

Fumigants which are gaseous such as sulfur dioxide or high vapor pressure liquids such as carbon disulfide can gain direct entrance into the body through the respiratory system.

In all cases where the airborne concentration of pesticides may exceed the established Threshold Limit Value (TLV) suitable respiratory protection should be utilized. The type of protection required will depend upon the specific exposure situation.

There are three basic classes of respiratory devices:

### 1. Air Purifying

- a. Particulate filter respirators for non-volatile dusts and mist.
- b. Chemical cartridge respirators for low concentrations of gases and vapors (less than 1,000 ppm) and for dusts and mists with particulate prefilter.
- c. Gas masks for concentrations of gases and vapors normally up to 2% by volume, but with exceptions (e.g., phosphine is limited to 0.5%). Also for dusts, with particulate filter. Chin style gas masks because of their smaller size are limited to gaseous concentrations not in excess of 0.5% by volume.

### 2. Air Supplied

- a. Airline respirators.
- b. Hose masks.

### 3. Self-Contained

- a. Demand masks (air or oxygen).
- b. Oxygen cylinder recirculating.
- c. Self-generating.

Proper selection depends on the following factors:

1. Oxygen content of air.
2. Type and concentration of contaminant.

The attached hazard chart published by the U. S. Bureau of Mines is an excellent selection guide. The Bureau of Mines and more recently the National Institute of Occupational Safety and Health (NIOSH) are the official government testing and approval agencies for respiratory devices.

In the latest listing of approval schedules (30 CFR Part 11, issued March 25, 1972, and effective May 25, 1972) the Bureau has included a test schedule for pesticide respirators under Sub. Part M. The pesticide schedule basically covers air purifying devices, including front-and back-mounted gas masks, chin style gas masks, chemical cartridge respirators and air purifying respirators with attached blower. In addition, specific performance schedules for fumigants such as hydrocyanic acid and phosphine are also included under Sub. Part I covering gas masks.

The U. S. Department of Agriculture had previously tested respirator cartridges and gas mask canisters against specific pesticides (other than fumigants) and lists of acceptable devices were published periodically. The last such

listing was ARS Bulletin 33-76-2 published in February 1966. Such listings of accepted devices will be valid until March 30, 1974, after which time all pesticide respirators must be approved under 30 CFR Part 11.

Under the Occupational Safety and Health Act specific reference is made to the American National Standards Institute (ANSI) Standard Practices for Respiratory Protection Z88.2 issued in 1969, thus making this standard a part of the law. Under the auspices of the parent Z88 committee, a sub-committee has been assigned to prepare a specific Z88 standard for Respiratory Protection Against Pesticides. This standard is currently under preparation and hopefully will be available by the end of 1972.

In summary, specific approved respirators can provide effective respiratory protection against airborne pesticides if they are selected carefully, worn properly and maintained in good condition. In this regard the following rules of thumb apply:

1. If there is any question of an oxygen deficiency (below 19.5% by volume at normal atmospheric pressure), which might occur in silos or other enclosed spaces, only self-contained equipment or a hose mask with blower should be used.
2. Most pesticides require the use of an efficient particulate prefilter in addition to chemical "absorbents" for adequate protection during spraying or dusting applications.
3. Half-mask respirators should not be used in concentrations in excess of 1000 ppm (0.1% by volume) or 5 mg/m<sup>3</sup>.
4. Gas masks are selected on the basis of their application for a specific contaminant or group of contaminants and are specifically labeled and color coded.  
Chin type canisters are normally restricted to concentrations not in excess of 0.5% by volume (5000 ppm). Industrial and supersize canisters are normally restricted to total concentrations not in excess of 2% by volume. Specific canisters are available for phosphine but are restricted to concentrations not in excess of 0.5% by volume.
5. Replace filter units of air purifying devices frequently to insure adequate protection. In the specific case of methyl bromide, gas mask canisters should be replaced (and destroyed) after each use because methyl bromide has poor retention characteristics in activated charcoal. After a few day's storage a partially used canister will evolve methyl bromide even when clean air is passed through it and thus becomes a potential hazard in itself.
6. Always don protective equipment and check for tightness before entering exposure area. Likewise, do not remove respiratory protective equipment before leaving the exposure area and before removing protective clothing.

Since many pesticides also present a hazard to or through the skin, protective clothing should be worn in addition to respiratory protection. In the case of organic phosphates and HCN, protective clothing is particularly important. Fatal poisoning can occur through skin absorption. Proper protective clothing should include impermeable coveralls, head cover, *unlined* rubber gloves, and goggles (if half-mask respirator is used). It is of paramount importance that masks and clothing be cleaned after each use to prevent them from becoming continuing sources of contamination. A good procedure to follow, particularly for detoxification of organic phosphates, is to soak the mask parts (with filters removed) and clothing in a 5% solution of sodium hydroxide (lye) or a strongly alkaline soap solution for a minute or two and then *rinse thoroughly* with clean water. Further cleaning of the mask parts with a good cleaner-sanitizer is also recommended.

Wearing the proper protective equipment and maintaining it in good condition are "common sense" procedures when handling pesticides.

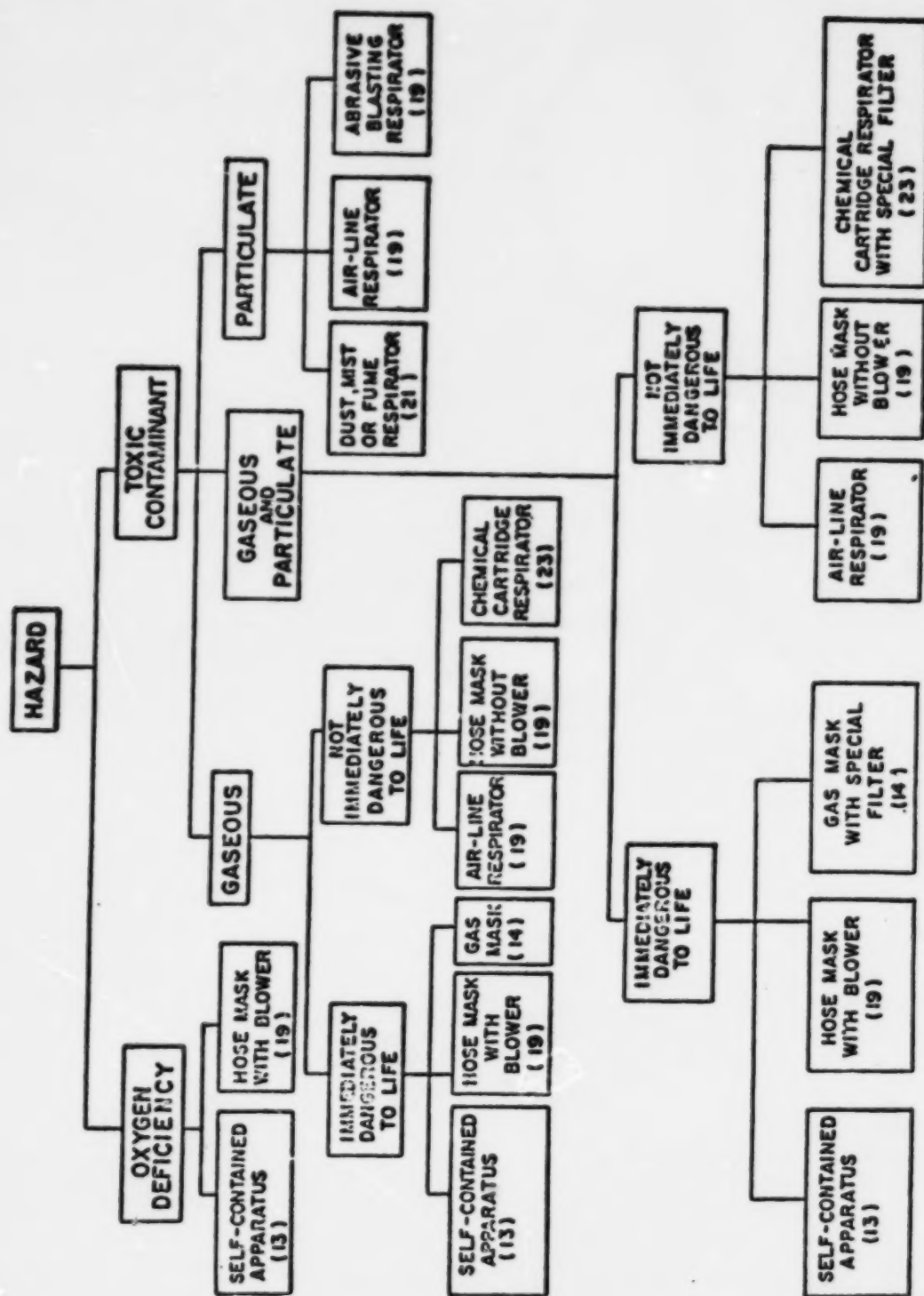


FIG. 1.1. Outline for selecting respiratory protective devices.

(After Bureau of Mines Information circular T792. Numbers in parentheses refer to Bureau of Mines Schedules and Revisions thereof).



## VENTILATION AND DUST CONTROL SYSTEMS TO PROTECT WORKERS IN ENCLOSED AREAS

by

*Dr. Robert Scott  
Chemagro Corp.  
Kansas City, Missouri*

My particular part of this program today is to discuss with you "Ventilation and Dust Control Systems to Protect Workers in Enclosed Areas." As you can well appreciate, this is a very complex subject. We can only hope to cover it rather generally in the time allotted today. Comments are from our experience in a large plant — but apply to smaller plants as well.

I believe that this topic can best be covered by considering two basic concepts of ventilation and dust control systems, the advantages and disadvantages of these concepts, the experience Chemagro has had with such systems, and lastly, some comments concerning operation of such a system.

The two basic concepts of ventilation, as we know them today, are general dilution ventilation and local-exhaust ventilation.

Dilution ventilation, accomplished by diluting the general room atmosphere with enough new air to keep the concentration of toxic air within safe limits, is most often used when the contaminant is a solvent vapor.

**Slide No. 1** gives several single examples of dilution ventilation.

The two examples on the left that are labeled "poor," show that complete room ventilation is not evident, and any dust and/or chemicals that are in the operating area will remain in this area.

Examples on the right-hand side of the slide have a little different concept of ventilation, where we have forced air extended through a plenum, forced either upward or downward, extending throughout the room where an exhaust fan removes the contaminant from the operator. Concept at top right is, of course, the best.

This type ventilation has advantages; it provides a high volume of air change for the comfort of the operators at a relatively low installation and operation cost, and it's adequate for low concentrations of solvent vapors and some fume contamination, such as welding operations.

Its main disadvantage, of course, is that it does not control contamination at its source. This system requires large volumes of make-up air, and is not adequate for highly toxic materials or for dry materials unless personal protective equipment is used and a strict program of air sampling instituted along with a medical surveillance program.

The other concept, the local exhaust system, is designed to capture air contaminants at their source before these contaminants can reach the breathing zone of operating personnel. This system consists of four main elements: hoods, ducts, dust arrester (cyclone separator, dust collector, etc.), and exhaust fan. A fifth element can be added to control odor (vapor scrubber). We will see these elements shortly.

This concept has many advantages. It removes contaminants before their spread throughout the room and environment; uses less make-up air because of the need for fewer air changes per hour; minimizes need for personal protective equipment; and is a means to recovering dust for reprocessing or disposal. The last two items should be emphasized — all dust is recovered, not admitted to the environment as is the case in dilution ventilation and operators do not need respirators.

The disadvantages of this type of installation, of course, is the cost of design, installation and operation. This type is considerably more expensive in all respects.

**Slide No. 2** is an example of an earlier Chemagro dust ventilation system. This is a combination of local exhaust and dilution ventilation. We had a make-up air unit of 40,000 cfm's dispersing air through the middle of the room. Two ceiling fans removed air at the rate of 15,000 cfm's each. Hoods are at the bagging line along with a 4,000 cfm dust collector, and at the raw material charging operator a 3,600 cfm dust collector.

Note there are no provisions for dust spillout on the packaging line or dust pickup at the blenders, and no odor control on the dust collectors.



This system was used by Chemagro for a number of years with very few problems with personnel exposure, primarily because an excessive amount of personal protective equipment was used. Whenever a spillout occurred on the packaging line, there was no mechanical method of recovery; therefore, the material was lost for all practical purposes and had to be discarded. We had approximately 15 air changes per hour throughout the room.

This combination of concepts can be used — as long as respirators are used. We wanted something better.

**Slide No. 3** shows a sketch of our new ventilation system in operation for less than one year. Our goal for this equipment was to provide maximum operating safety by minimizing exposure to dust and vapors without individual equipment and to maximize comfort of the operators. You will note we still have 40,000 cfm's make-up air; however, duct work has been installed throughout the room so that air is dispersed at 12-ft. levels, thereby reaching all parts of the room to improve comfort of operating personnel.

A large dust collector has been installed with a capacity of 7,500 cfm's (twice the original) and the raw material charging room dust collector was increased to 4,000 cfm's. The exhaust from these systems was tied in with a jet scrubber, using calcium hypochlorite solution for odor removal. In addition, a particle counter was installed between the exhaust of the dust collector and the scrubber to an alarm, in the event of dust collector malfunction.

The hoods on the packaging line were completely redesigned to add higher velocity at the exposure areas and to provide a means to recover spillout by returning the material to the system automatically.

Dust pick-up points were also located at each blender for ventilation when sampling occurs. There are dust pick-up ducts on the blender bearings, since the dust is an abrasive-type material causing the bearings to wear and leak. The system will pick up the leakage and return it to the dust collector until time for proper bearing repair.

The ceiling fans are not operated normally. We have 4 air changes per hour instead of the previous 15.

Not shown on the sketch are two overhead doors used for material movement. Units are installed over these doors to form an air curtain when the door is opened, to limit the loss of warm air during the winter and cross drafts from strong winds across face of the hoods.

This design has enabled us to control the dust at all points of exposure with only fresh air passing our operating personnel; therefore, we have eliminated completely the use of respirator protection, which has enhanced our employee morale considerably. It is still necessary, of course, to wear eye protection and gloves. We are very pleased with this installation and feel this is a major step forward since we manufacture a variety of dry formulations which are highly toxic and/or highly irritating toxic materials on organic phosphates.

In the event of a major spill in the area, the ceiling fans can be operated for fast area air evacuation. Personnel will, in this event, use respirator protection until the area has been decontaminated.

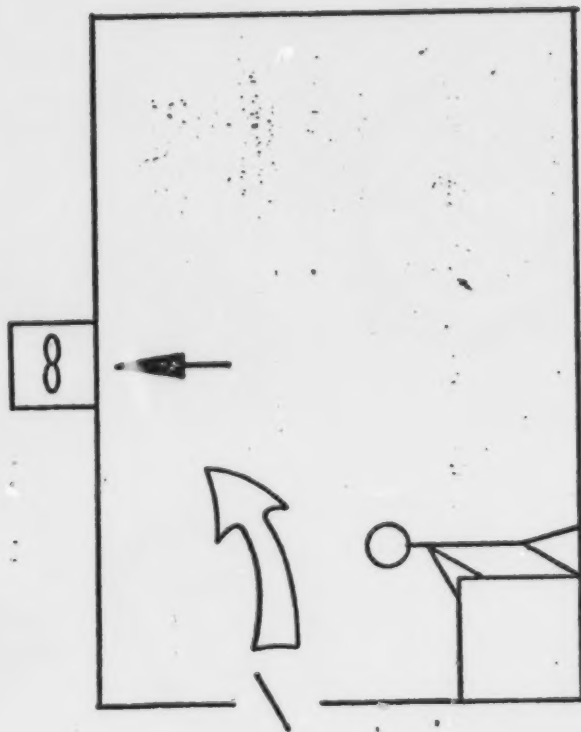
The most important aspect of ventilation and dust control is proper design. Only qualified personnel should do ventilation design work and installation. Where most errors in ventilation are made is in using the false concept that a hood under suction has the magic power to reach out, perhaps across the room, and draw contaminated air into it. Actually air movement becomes very small a few inches from the hood face.

There is one manual on ventilation I think is a must for your files titled "Industrial Ventilation Manual," 11th edition, published by the American Conference of Industrial Hygienists. Ventilation systems installed as prescribed in this Manual will be proper and satisfactory. This Manual can be purchased from the Committee on Industrial Ventilation, P. O. Box 453, Lansing, Michigan, 48902, at a price of \$4.00.

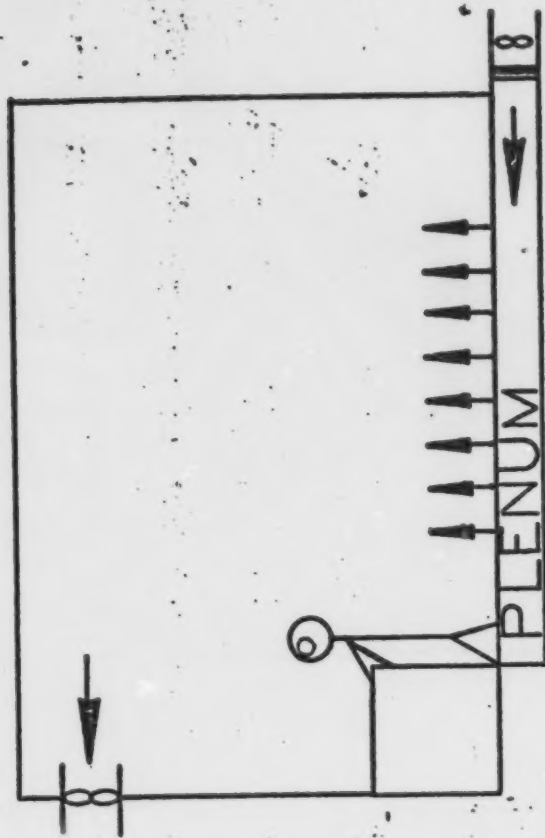
After a good ventilation system has been installed, it must be checked periodically to ensure its efficiency. There are some very elaborate methods for ventilation control, and a qualified engineer or industrial hygienist should do this type inspection. Since many of us do not employ such people and we do not have the test equipment required, there are a few simple methods of field inspection that can be used:

1. Make and study a simple line drawing showing the layout of each main duct and branch, together with the location of the arrester, fan and motor. Study drawing — look for engineering weaknesses in layout.
2. Periodically inspect ducts, hood, fans, motors, etc. There is no substitute for good maintenance.
3. Periodically check for alterations in the manufacturing process and machinery. Operating people have a habit of changing things without notice.
4. Make sure replacement air continues to have ample opportunity to enter the room.
5. Use smoke tubes and smoke bombs for visually testing the path of air currents and effectiveness of hoods.

In this presentation I have attempted to describe and differentiate in general terms two different concepts in ventilation and dust control; the advantages and disadvantages of both, to discuss Chemagro's experience briefly, and thus, to tell you that it is possible to produce dry dust pesticide formulations in a properly ventilated plant without personal breathing equipment for personnel, without losing pesticides to the environment and with safety and comfort for operating personnel.

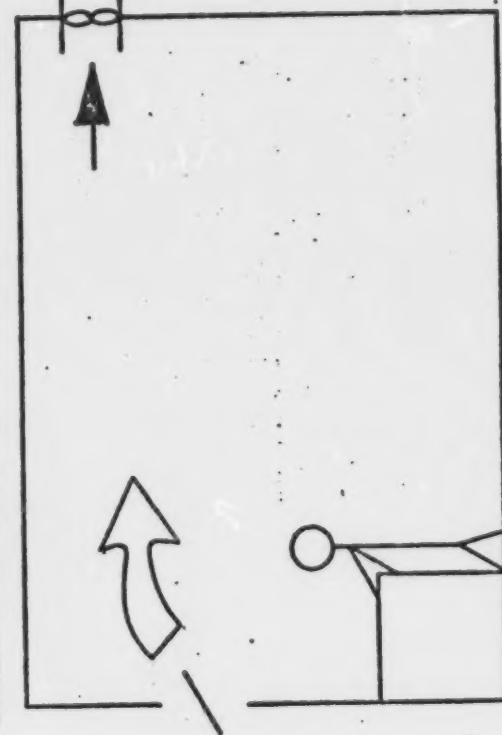


POOR

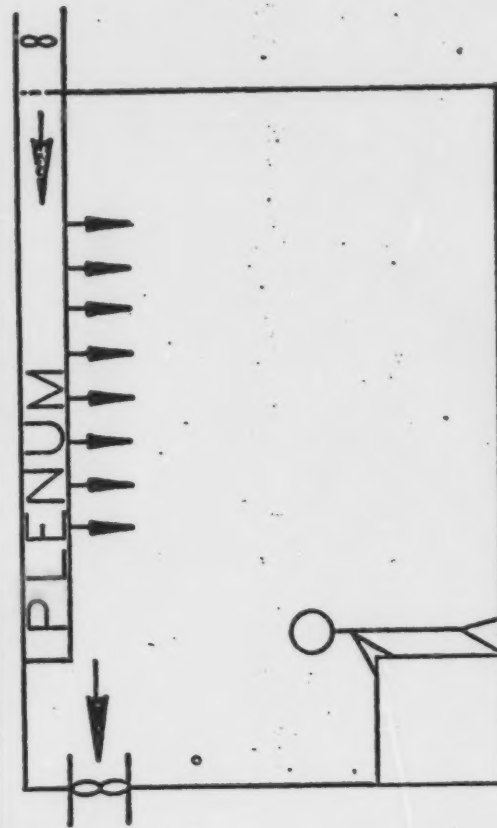


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EXAMPLE OF DILUTION VENTILATION

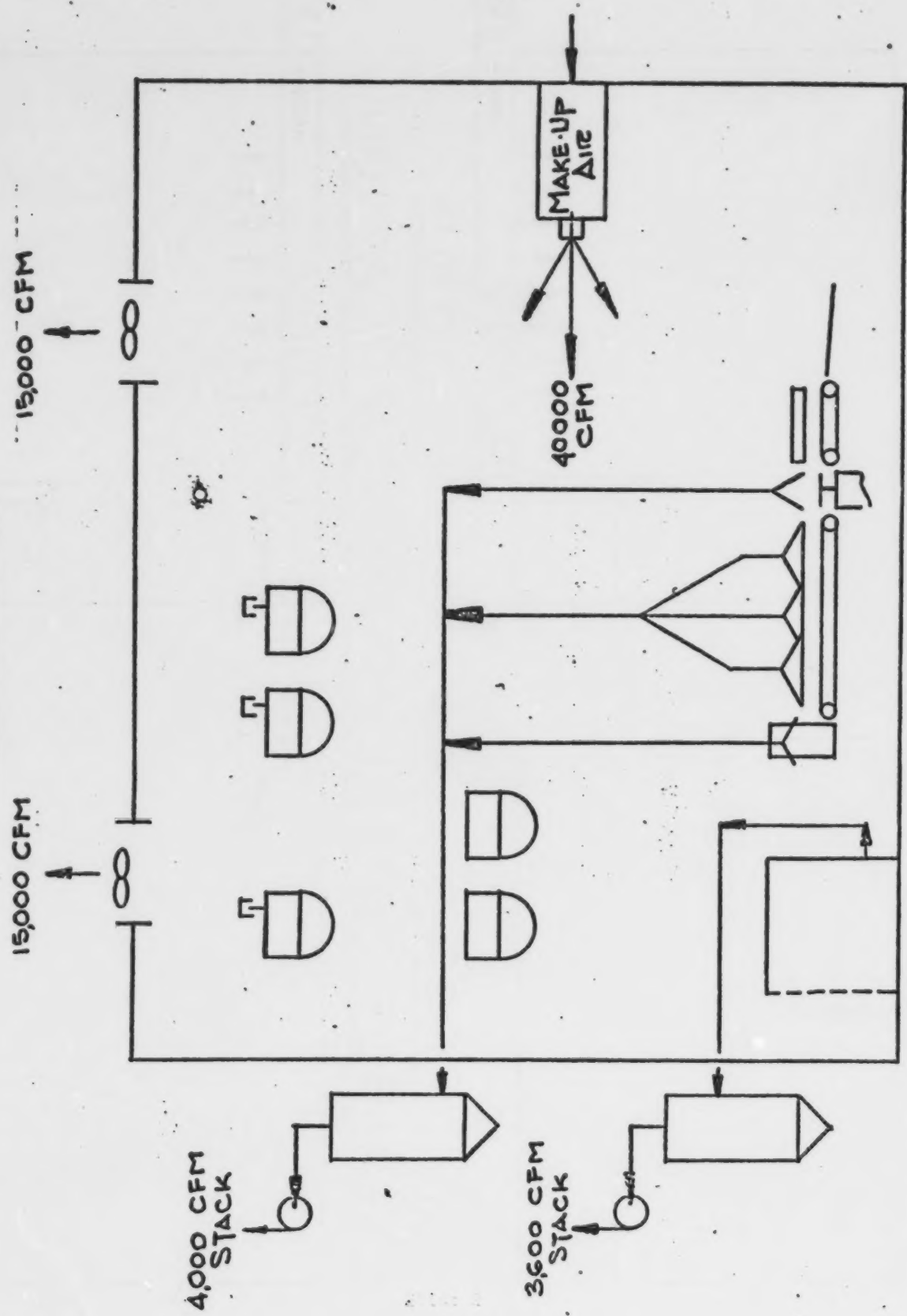


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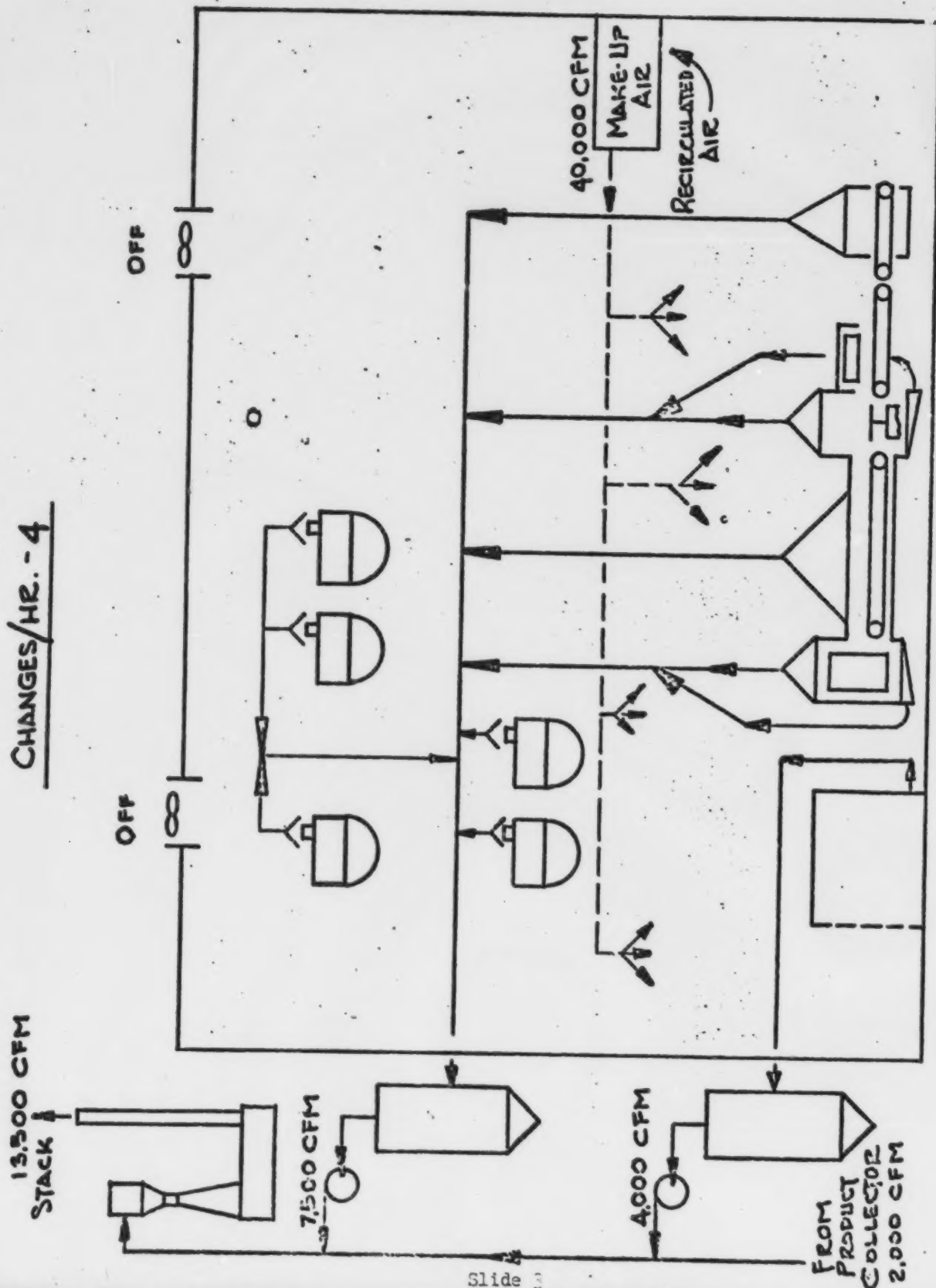
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CHANGES/HR. - 15



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CHANGES/HR. - 4



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## INNOVATIONS IN PESTICIDE APPLICATION EQUIPMENT THAT PROTECT WORKERS FROM EXPOSURE TO PESTICIDES

by

*John R. Hagie  
Power Sprayer and Duster Council  
of the  
Farm and Industrial Equipment Institute  
Chicago, Illinois*

I want to thank Dr. Preston for inviting the Power Sprayer and Duster Council of the Farm and Industrial Equipment Institute to participate in this National Conference and to allow us to present our report on safety in regard to pesticide application equipment. This Conference is pertinent and appropriate and should start a dialogue leading to a better understanding of pesticide safety as the various sections speak to specific aspects of pesticide safety and the nature of the pesticide safety problem.

If man continues to change his environment at the present rate, there is little question that pesticide usage must increase and that this increased usage must be accomplished at a level consistent with the society's concern for the right to work and exist without undue harm.

The broad variety of protective clothing and safety equipment available was outlined earlier. We do not, however, know too much of the behavioral factors relative to utilizing safety devices. It is hoped that the discussions during these two days will lead to describing the development of a scientific base for implementing pesticide safety.

Our review indicates that pesticide application safety requires a systems approach. This involves the identification of scientifically based safety practices, safety system responsibility, coordinated regulation and a data system which is capable of producing accident information useful to all of the groups holding a responsibility in the safety system.

We have made reference to a pesticide application safety system. We would now like to define specific elements that we believe are important to that system.

The focal point of pesticide application safety must start with the formulator, who determines to what the pesticide should be applied, what mixing procedures to use and at what rate it shall be applied. He should also determine what disposal procedures should be followed in the matter of excess pesticides and empty containers. He must also recommend antidotes and clean-up procedures. The formulator must establish guidelines for every step of distribution and these must be followed in implementing any pesticide safety program.

We in the Application Equipment Industry extend our safety interest and concern beyond the reference base outlined by the formulators; and therefore, we feel the second stage of pesticide safety is the training and/or qualification of the pesticide handlers and applicators. We believe that training and qualification should be related directly to the degree of hazard exposure engendered with a given pesticide formulation.

A third step in pesticide safety is the selection and calibration of application equipment. As the use of a pesticide expands, there is little doubt that mechanized application is the answer to the pesticide safety problem by virtue of the fact that mechanization has the capability of providing precise control. We want to draw your attention to the fact that the formulator generally does not recommend the selection of a given type of machine for applying the pesticide. Pesticides are generally applied by available machines, and it is the applicator who determines if his machine is capable of applying the pesticide at the rate recommended by the formulator.

Assuming that there is an accident involvement the safety system calls for a series of emergency actions to reduce the degree of hazard. The capability of responding in an emergency is at this time relatively limited in that precise information as to what exactly should be done in the emergency situations may not be available to the applicator or to the medical group treating an accidental involvement. In general, too few people have a knowledge of the emergency actions which should be taken in relation to the short-and long-term effects of an accidental involvement.

Within the complete pesticide safety system, machine applicator involvement narrows down to relatively few areas. The first need is to provide for effective machine operator training. There are now existent within various governmental agencies regulatory provisions whereby federal resources are assigned to train both employer and employee in safe operating practices. Some application machinery manufacturers hold training schools for application equipment owners and operators, thus adding a second and important phase of operator training to the pesticide safety system.

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Private training has a dual purpose because the application equipment manufacturer not only responds to the need to handle pesticides safely but concentrates on protecting the operator from any mechanical hazards that may exist.

There is at least one company in our industry who invites all new application equipment owners to a training session where the company's Service Department explains the mechanical aspects of the equipment and includes an intensive session on five (5) basic operating fundamentals. These fundamental steps to chemical control are to know your particular pest problems and determine which product and rate of application will do the best job; have a specific plan to use the right amount of the right chemical at the right time; secure and have ready the appropriate and necessary chemical product; determine whether or not the available chemical carrier needs to be treated to obtain optimum results; maintain adequate records for each chemical application including data on check strips. Major emphasis is placed on following all available directions concerning safety in effective chemical use.

Pesticide applications demand precision and this necessitates extensive guidelines for sprayer calibration. Additional sessions in this particular private school include explanations in the safe handling of pesticides, respiratory devices, a plan of action for residues, attention to the decal instructions that are attached to every application machine and the correct use of the operator's manuals.

Application machinery involves the educational base we just reviewed plus two classes of safety devices. The first class of safety devices is personal safety devices such as rubber gloves, respirators, goggles and clean-up material such as water for rinsing and neutralizing solutions. We are forced to rely on the operator's safety sense in intelligently using the personal safety devices.

A second and growing stage of protection in spray machinery is safety devices for complete environmental control. We are referring particularly to vehicle cabs with their potential for a well-protected operator's environment. Operator cabs are generally installed on self-propelled application machines where an energy source is available to power the environmental system. Total environment control is growing at a rapid rate. Air conditioning for temperature control, noise abatement measures and air filtering systems for typical non-toxic agricultural dusts are all available. In general, there appears to be more acceptance for using a complete environment control system than there is for using the personal safety system.

The Equipment Industry is doing additional work to minimize operator exposure due to spray drift by concentrating its efforts in the area of nozzle technology. A spray nozzle capable of producing a foam-like substance is gaining in popularity. Low volume application, low pressure spraying and overspray control through the use of surfactants, electrostatics and foams are all being worked on constantly and each one will help reduce the dangers that may exist to man and his environment.

A relatively new innovation is remote application control utilizing electronic nozzle shut-offs that can be located away from the actual application devices. Bulk handling and limiting exposure in mixing is an area where much work is being done and is resulting in increased operator safety by physically separating him from actual contact with the pesticide.

Our industry has made a great deal of progress in the area of operator safety. We encourage the use of the personal safety devices such as goggles, respirators and gloves. In many cases these are made available with a new piece of equipment and in most all instances, are available through the equipment supplier who in his own right is an expert in his chemical application safety practices.

Improvements have been made in safety in relation to mixing procedures. We see a considerable progress in developing a controlled environment. A great deal of emphasis is placed on the training and/or qualification of the machine operator and this is accomplished through schools, both governmental and private, as well as detailed safety instructions in the operator's manual.

Our review indicates that future innovations in pesticide application equipment safety will come at a slower rate unless we see a coordinated effort of some of the things that are pertinent to this conference. We in the industry need an accident data bank that not only records the number of accidents but provides detailed information which describes how the accident happened and the measures which should be taken to prevent a similar accident in the future. From this data bank would come scientifically based safety practices that would provide a priority of behavioral actions so that the people working with pesticides will be able to ascertain the degree of risk connected with a given behavior. In the case of application machinery manufacturers we can assess the machine's capabilities to apply a proper rate under conditions which implement safety. The data bank should be able to assess safety system responsibility.

We find that safety education is lagging behind safety hardware production and, consequently, we are not getting the benefits of an integrated safety system approach. Above all, the safety system should provide a read-out on where we have been, what has been successfully done, where we should be going, and how the pesticide safety activity can be coordinated into a total pesticide safety system.

## OCCUPATIONAL HEALTH AND SAFETY STANDARDS THAT APPLY TO PESTICIDE EXPOSURE SITUATIONS WHERE PROTECTIVE CLOTHING AND SAFETY EQUIPMENT ARE NEEDED

by

*Mr. Charles Wilson  
Occupational Safety and  
Health Administration, DOL  
Washington, D.C.*

The Occupational Safety and Health Act of 1970 has been described as a safety "Bill of Rights" for more than 60 million workers across the country. It's been attacked. It's been praised. And it's been misunderstood.

So for the first few minutes, I'll discuss the Act in general. Then I'll discuss its application to the problem we are here to cover.

From 1926 until 1960 our national productivity increased. At the same time, we saw a general decline in the annual injury frequency rate. This was an improvement in what we in OSHA now call "protectivity." In the 1960's the protectivity curve took a change for the worse. The injury frequency rate began an increase. This increased the awareness of the need to improve safety and health conditions in the nation's work-places.

The Williams-Steiger Occupational Safety and Health Act of 1970 was the solution. Its objective is to bring the protectivity curve back to its traditional position—with the injury rate dropping as productivity continues to climb.

In general, the Act requires employers to furnish their employees a hazard-free environment. Employees have the duty to comply with all rules, regulations and orders issued under the act which apply to them.

The Act gives the Secretary of Labor the responsibility of setting safety and health standards. These are regulations aimed at eliminating on-the-job hazards. Every employer and employee must comply with them.

The Act establishes the Occupational Safety and Health Administration, which we call OSHA, to put the Act to work and to see that standards are met. It requires employers to keep records on job-related deaths, injuries and illnesses. Selected establishments are being asked to submit additional reports based on these records to give us a more accurate profile of accidents and the how and why of them. The number of firms reporting will expand to 250,000 by 1973. Data from these reports will help to determine standards and priorities in coming years.

OSHA is decentralized to put its staff where accidents and health hazards occur at the local level. More than 75 percent of our staff is located in our 10 Regional and 48 Area Offices. More than 400 Compliance Officers work out of these offices. They inspect establishments—which include farms—to see that standards are met. They issue citations on alleged violations. Depending on the violation, there may be imposed any one of a full range of penalties that put teeth in the Act. But more important, penalties provide the incentive for employers to comply voluntarily with standards even before they are inspected. This voluntary compliance is the essence of the Act.

The Act sets up the National Institute of Occupational Safety and Health under HEW as a research facility, also establishes a commission to study state workmen's compensation laws to make them more equitable and adequate, orders education and training programs to be held, and encourages states to develop their own safety and health programs.

The Act requires all employers to keep up-to-date logs of recordable occupational injuries and illnesses. These records must be available at the time of an inspection.

The forms necessary to keep the records are available in a booklet "Record Keeping Requirement" which was mailed to all employers beginning in mid-1971.

Also included in the booklet is a centerfold. Not a "bunny," but something very important. It is a poster that all employers must post conspicuously in a prominent place for employees to see usually where they report to work. The poster explains the Act and the responsibility of employers and employees to maintain safe and healthful working conditions.

The first sample reporting group will consist of approximately 14,000 establishments.

Whether or not included in this sample, all employers still have a reporting responsibility. They must report any work-related accident that results in one or more fatalities or hospitalization of five or more employees to OSHA within 48 hours.

The Act provides Small Business Administration assistance to employers to help purchase required safety equipment or to make modifications to comply with standards. Unfortunately, one exception to this is that under federal regulations applying to the Small Business Act, purely agricultural operations are not eligible for SBA loan assistance. However, agricultural processors whose use of their own raw products does not exceed half of their total requirement may be eligible for SBA assistance. Others should contact their normal lending agencies or farm extension agents for information on loan sources applicable to them.

The voluntary compliance of every employer and employee is vital to the success of the Act. The goal is a safe and healthful work environment for all workers. Even one workplace death is too many. Working together we can cut the toll.

Now, how has this Act affected the manufacture, storage, sale and use of pesticides? As authorized by the Act in the initial standards package as appeared in the May 29, 1971, Federal Register there were promulgated only existing federal safety and health regulation and recognized nationally consensus standards developed by the American National Standards Institute and the National Fire Protection Association.

Careful consideration was given each standard prior to its being included in this package and as a result only a relative few were issued of all those available.

Among those standards accepted was the Threshold Limit Values of Airborne Contaminants and Physical Agents table as developed by the government industrial hygienist and issued as a Federal Standard under the Public Contracts Act. This table was intended to protect workers with a possible exposure to these substances in a day-in-and-day-out situation as part of their employment. While suitable for every day activities it does not offer adequate protection to persons in an emergency or the equipment to prevent emergency situations. In addition at the present time under the provision of subparagraph 1910.267 as found in the initial standard package this standard does not apply to agricultural operation including commercial application.

There is under section 5(a)(1) of the Act the general duty clause which requires the employer to furnish each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees. This general duty clause may be used in any situation in any industry where such serious threat to the welfare of the employee can be shown.

In his message to congress the President announced that he was directing the Secretary of Labor with the help of the Secretary of HEW to issue standards for protection of agricultural workers under the Act. Needless to say this will receive the highest priority in our effort to issue effective standards for the protection of farm employees.

**REGULATIONS GOVERNING HAZARDOUS CHEMICALS IN  
LOADING AND TRANSPORTATION OPERATIONS  
WHERE PROTECTIVE CLOTHING AND SAFETY EQUIPMENT SHOULD BE AVAILABLE**

by

*Mr. Judge R. Shelton  
Bureau of Motor Carrier Safety, DOT  
Washington, D.C.*

Under the Department of Transportation Act (Public Law 89-670), all safety personnel in the Interstate Commerce Commission on April 1, 1967, were transferred to the U.S. Department of Transportation, Federal Highway Administration, and as a result the safety regulatory and enforcement functions with regard to the transportation of hazardous materials by motor carrier is now carried out by the Bureau of Motor Carrier Safety, under the Federal Highway Administration, operating in the current ten Regional operational system.

The Bureau of Motor Carrier Safety has field staff members in each of the Continental 48 states and Alaska. Headquarters for the Bureau of Motor Carrier Safety is in Washington, D.C.

On June 1, 1970, there was created within each region a new position titled "Regional Hazardous Materials Specialist." The specific duties of this position require him to spend almost all of his time in field work involving hazardous materials, such as accident investigation, checking shippers, motor carriers, conducting investigations, and contacting chemical and container manufacturers. This position of "Regional Hazardous Material Specialist" was created by demand, due to the increased production and transportation of hazardous materials. The basic responsibility and mission of the Bureau of Motor Carrier Safety in the field of Hazardous Materials Transportation is to assure maximum protection to the public when hazardous materials are transported by highway.

The regulations relating to the transportation of hazardous materials are basically found in these publications:

1. Code of Federal Regulations Title 49 Parts 100-199
2. The Interstate Commerce Act (Explosives and other Dangerous Articles)
3. Code of Federal Regulations Title 49 Parts 390-397 (Motor Carrier Safety Regulations)

The driving regulations that prescribe the special rules for those drivers who transport hazardous materials is set forth in Part 397 of the Motor Carrier Safety Regulations.

It is noted that the scope of jurisdiction also includes intrastate shipments when a shipper utilizes the services of an interstate carrier. The Bureau of Motor Carrier Safety works very closely with State regulatory and enforcement agencies and all emergency responding personnel such as volunteer fire departments and rescue squads. We are currently carrying out an extensive educational program with emergency responding people throughout the country in order that they may become more knowledgeable of required regulations in the transportation of hazardous materials.

The Regulations Division in the Bureau of Motor Carrier Safety Headquarters at Washington, D.C., is continually making amendments to the current regulations and initiating rule making procedures involving the transportation of hazardous materials to keep highways, drivers and the general public safe during the transportation of hazardous materials even though accidents occur enroute.

To illustrate what can happen during the course of transportation of pesticides, I relate to you in part an accident that occurred near Blythe, California, on October 3, 1967. The complete information of this particular accident investigation is contained in a Bureau of Motor Carrier Safety published report, No. 67-12. During the investigation of this accident by local authorities and also during the decontamination and cleanup operations after the accident, there were highway patrolmen, insurance investigators and highway cleanup people who became contaminated at the accident scene, who required hospitalization and the administering of antidotes. During the course of this accident, nine people became contaminated and over 50 people were tested for contamination. The motor carrier in this particular case was in direct violation of specific regulations relating to the transportation of hazardous materials on this trip. The motor carrier at a later date appeared in the U.S. court and was fined for specific hazardous materials violations.

During the course of checking production records of major manufacturers and shippers, together with export and import records, we find that the transportation of Class B poison pesticides is up some 25 per cent in the past five years.



Obviously our exposure rate to accident and spills have also gone up considerably with relation to highway transportation of pesticides materials.

I personally commend the Manufacturing Chemist Association regarding their Chemtrec Program and all those chemical manufacturers participating in the pesticide decontamination centers set up throughout the United States. I personally can state that the response received through the pesticide decontamination center has been excellent with immediate response to any major situations involving the spill of Class B poison pesticides.

Since the requirement of the new hazardous materials reporting procedure on hazardous materials incidents occurring in transportation, for the first time we are beginning to get factual data on hazardous materials incidents involving spills during the course of transportation in all modes.

Specifically, the law requires that if there is an unintentional release of hazardous materials during the course of transportation, the carrier must report on a prescribed form and submit this form to the Office of Hazardous Materials within 15 days after the incident occurred. The regulations also provide that if the incident involves \$50,000 property damage or any death or treatment requiring hospitalization of any individual, there must be an immediate telephone call made reporting the incident to the 24-hour Washington, D.C. number which is monitored by the U.S. Coast Guard. In addition to immediate notification, within 15 days a written report must also be made. Prior to the advent of this specific regulation, the regulations pertaining to reporting were extremely lax.

Currently during the process of investigating hazardous materials incidents and checking shippers and carriers in field operations, we have found many incidents have occurred in the past where workers have become poisoned in handling pesticides and no report was ever made, which leads me to believe that there are no really dependable statistics at this time to tell us just how many people become contaminated in the handling of Class B poison pesticides throughout the entire country in all modes of transportation.

In two recent cases investigated within the past 12 months, we discovered that two investigators became contaminated while taking measurements and pictures at an accident scene involving the spillage of a cargo containing Class B poison pesticides.

In another recent incident a State police officer became contaminated while inspecting a cargo of Class B poison that contained "leakers" at a scale location.

Within the next two or three years we hope to have considerably more information on incidents involving the transportation of pesticides so we can readily identify specific problem areas and take decisive action.

During the period that I was assigned as a field staff member in the Southern California area, it became a part of my duty to participate in approximately 18 pesticide spills and an additional 6 spills while assigned in our Northwest Regional office. My first personal experience with a pesticide incident occurred in Tijuana, Mexico, where upon request, assistance was given to representatives of the Mexican government in the investigation of a pesticide incident occurring in transportation that resulted in the death of 18 children and hospitalization of approximately 145 more people. The particular pesticide involved in this spill was "PARATHION 25 Percent" in a wettable powder form in paper bag containers packaged in Mexico. Since the Tijuana incident we have had several other incidents involving spills from drums and other types of containers in the Continental United States.

There has not yet been any catastrophic loss of life due to a pesticide spill here in the United States. I have personally investigated several highway transportation spills involving shipments to foreign countries under the Agency for International Development program and other government programs involving foreign commerce shipments.

To my knowledge, there are no regulations presently in effect that require protective clothing and related safety equipment to be carried in a motor vehicle transporting Class B poison pesticides, or be in possession of a driver during the course of such transportation. We are continually looking to industry for recommendations relating to the transportation of hazardous materials with respect to what is actually needed in the form of individual equipment and protective clothing or devices.

I sincerely solicit your recommendations and discussion during this conference and at any time in the future.





U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION  
BUREAU OF MOTOR CARRIER SAFETY

REGIONAL AND FIELD OFFICES

REGION 1 - 4 Normanskill Blvd., Delmar, New York 12054\*

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| Los Angeles, Calif. | Phoenix, Arizona | Carson City, Nev. |
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REGION 10 - Room 412 Mohawk Bldg., 222 S. W. Morrison Street, Portland, Oregon

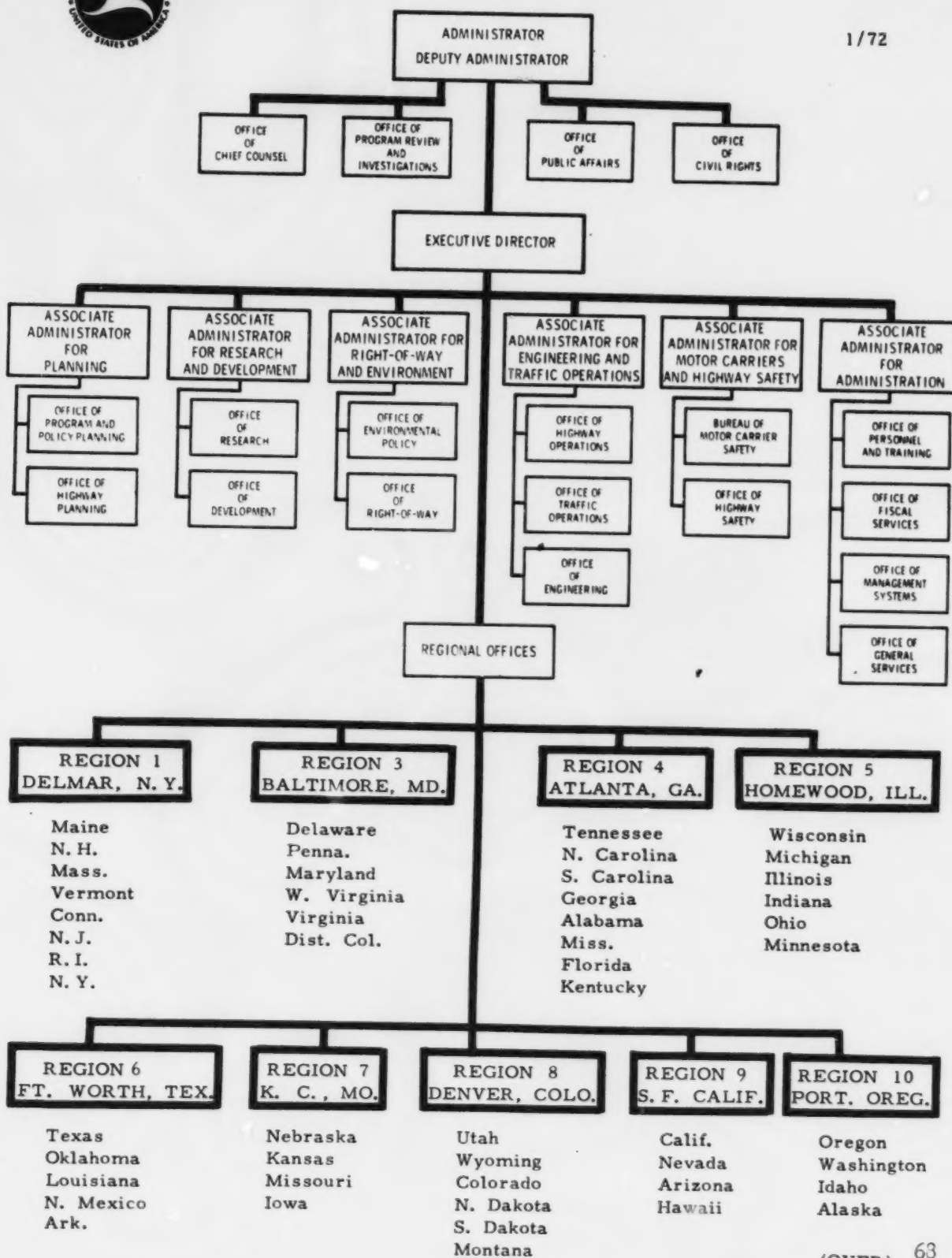
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| Seattle, Wash. | Boise, Idaho      | 97204* |
| Spokane, Wash. | Anchorage, Alaska |        |

\*Denotes address of Regional Offices.



U.S. DEPARTMENT OF TRANSPORTATION  
FEDERAL HIGHWAY ADMINISTRATION

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**Region 1 \* Connecticut, Maine, Massachusetts, New Hampshire, New Jersey,  
New York, Rhode Island, and Vermont**

Michael D. Sullivan, DRMCSO  
4 Normanskill Boulevard  
Delmar, New York 12054  
AC 518-472-7509, Com. Same

Russell G. Toth, RHMS  
Raymond Valentine, RAIS, and  
George T. Janson, S/I  
(Same address as RD Sullivan)  
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Ralph E. Johnson  
990 Wethersfield Avenue  
Hartford, Connecticut 06114  
Tel. 203-244-2036  
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Frederick J. Gruin, Jr.  
614 Federal Office Building  
111 Huron Street  
Buffalo, New York 14203  
Tel. 716-842-2136  
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Richard Besanko  
Federal Building & U.S. Post Office  
Room 614, 40 Western Avenue  
Augusta, Maine 04330  
Tel. 207-622-6262

John C. Goodwin, John Whalan,  
John W. Spivey, William L. Taylor  
and Jack G. Takakjian  
U. S. Custom Court & Federal  
Office Building  
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New York, New York 10007  
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Gerard M. O'Brien, Matthew Pratt &  
P. Joseph Gibbons  
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John F. Leary, Jr.  
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Com. 802-223-6754

\*Conforms to Standard Federal Regions 1 and 2  
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**Region 3 Delaware, Maryland, Pennsylvania, Virginia & West Virginia**

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William C. Savage, RHMS, and  
Darwin D. Garvin, RAIS, and  
Clarence C. Cain, S/I  
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James W. Heinemann  
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Bernard F. Schilling &  
Patrick Quigley  
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N. Washington Ave.  
Scranton, Pa. 18503  
Tel. 717-344-7325  
Com. 717-344-7111

George F. Neunz  
Rm. 416, Old Post Office  
Building  
12th & Chapline Streets  
Wheeling, West Va. 26003  
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Com. 304-232-6430



**Region 4 Alabama, Florida, Georgia, Mississippi, North Carolina,  
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William L. Barrow, Jr. RHMS, and  
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Jimmie B. Sutton, S/I  
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John J. Fulnecky & Buddy C. Yount  
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ISTA Center  
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Herber Dixon  
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Mayland B. Nelms, Jr.  
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William A. Crowder, RHMS  
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Norris J. Freeman, RAIS  
Tel. 816-361-7896  
Com. 816-361-0860 Ext. 7896  
James A. Twigg & Bernard L. Watson  
Tel. 816-361-7898  
Com. 816-361-0860, Ext 7898  
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**SAFETY INVESTIGATORS**

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Com. 515-232-0250 Ext. 411

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Robert C. Thompson  
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Sioux City, Iowa 51102  
Tel. 712-252-0270  
Com. 712-252-4161 Ext. 270

Robert L. Wescott, Jr.  
Paul Reamy  
512 West 6th Street  
Topeka, Kansas 66603  
Tel. 913-234-8216, 17  
Com. 913-234-8661  
Ext. 216 & 17

Darrell C. Gregory  
P. O. Box 148  
209 Adams  
Jefferson City, Missouri 65101  
Tel. 314-442-3238 or 9  
Com. 314-636-7104

Wayne Cole  
3248 Federal Bldg.  
1520 Market Street  
St. Louis, Missouri 63103  
Tel. 314-622-4105  
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Robert E. Kitzmiller  
1701 S. 17th Street  
Lincoln, Nebraska 68502  
Tel. 402-475-3631  
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Dale L. Meiner  
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Luther H. Oldham, Jr., DRMCSO  
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Harold E. Farsdale, RAIS  
Orris H. Gram, and  
Harold E. Beetem, S/I  
(Same address as RD Oldham)  
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Com. 303-233-3611, Ext. 2330

**SAFETY INVESTIGATORS**

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Com. 406-442-9040, Ext. 3224

Ronald Evenson  
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Tel. 701-255-4204  
Com. 701-255-4011 Ext. 204

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James S. Brunton  
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Rudy Black, RHMS  
Eugene A. Graham, RAIS  
Danial Mulcahy, S/I  
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Gerald Birkland, S/I

**SAFETY INVESTIGATORS**

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230 North First Avenue  
Phoenix, Arizona 85025  
Tel. 602-261-3751

Harold E. Whitaker, Walter J. Hannigan, &  
Steven J. Polyi  
Federal Building  
Room 3062  
300 North Los Angeles Street  
Los Angeles, California 90012  
Tel. 213-688-4842, 3 or 4  
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Portland, Oregon 97204  
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Vacancy, RHMS, Albert T.  
Williams, S/I, Bert F. Quillin, RAIS  
and Robert M. Hagan, S/I  
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Com. 503-226-3361, Ext. 1792 & 3

**SAFETY INVESTIGATORS**

George D. Arnot  
1515 13th Street  
Anchorage, Alaska 99501  
Tel. 907-279-5213\*  
Com. Same

Bruce M. Fleming  
707 Alaska Building  
618 Second Avenue  
Seattle, Washington 98104  
Tel. 206-442-4388  
Com. Same

Frank A. York  
3010 State Street  
P. O. Box 7527  
Boise, Idaho 83701  
Tel. 208-342-2536 & 7  
Com. 208-342-2711, 2536, or 2537

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402 U. S. Post Office Building  
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## Appendix C

### 173.343 LESS DANGEROUS POISONS, CLASS B, LIQUID OR SOLID, POISON LABEL; DEFINITION.

(a) For the purposes of Parts 170-189 of this chapter and except as otherwise provided in this part, class B poisons are those substances, liquid or solid (including pastes and semisolids), other than class A or class C poisons, which are known to be so toxic to man as to afford a hazard to health during transportation; or which, in the absence of adequate data on human toxicity, are presumed to be toxic to man because they fall within any one of the following categories when tested on laboratory animals:

(1) **Oral toxicity.** Those which produce death within 48 hours in half or more than half of a group of 10 or more white laboratory rats weighing 200 to 300 grams at a single dose of 50 milligrams or less per kilogram of body weight, when administered orally.

(2) **Toxicity on inhalation.** Those which produce death within 48 hours in half or more than half of a group of 10 or more white laboratory rats weighing 200 to 300 grams, when inhaled continuously for a period of one hour or less at a concentration of 2 milligrams or less per liter of vapor, mist, or dust, provided such concentration is likely to be encountered by man when the chemical product is used in any reasonable foreseeable manner.

(3) **Toxicity by skin absorption.** Those which produce death within 48 hours in half or more than half of a group of 10 or more rabbits tested at a dosage of 200 milligrams or less per kilogram body weight, when administered by continuous contact with the bare skin for 24 hours or less.

(b) The foregoing categories shall not apply if the physical characteristics or the probable hazards to humans as shown by experience indicate that the substances will not cause serious sickness or death. Neither the display of danger or warning labels pertaining to use nor the toxicity tests set forth above shall prejudice or prohibit the exemption of any substances from the provisions of Parts 170-189 of this chapter.

### 177.800 PURPOSE OF REGULATIONS IN PARTS 170-189 OF THIS CHAPTER.

(a) To promote the uniform enforcement of law and to minimize the dangers to life and property incident to the transportation of hazardous materials, by private, common and contract carriers, by motor vehicle engaged in interstate or foreign commerce, the regulations in Parts 170-189 of this chapter are prescribed to define these articles for motor vehicle transportation purposes, and to state the precautions that must be observed by the carrier in handling them while in transit. *It is the duty of each such carrier to make the prescribed regulations effective and to thoroughly instruct employees in relation thereto.*

### 177.811 ASTRAY SHIPMENTS

(a) Any astray shipment of hazardous materials other than explosives must be forwarded promptly to destination, if known, provided a careful inspection shows the package to be in proper condition for safe transportation. If the package is not labeled and the exact nature of the contents is unknown, the red label must be applied.

### 177.815 LABELS

(a) Labels prescribed in Sections 173.402 through 173.414 of this chapter must have been applied to packages by the shipper, unless exempted from the labeling requirements, the exemption being noted on the shipping papers.

(e) Carriers must keep on hand an adequate supply of labels. Lost or detached labels must be replaced from information given on waybill, manifest, memorandum, or other shipping paper.

## 177.817 SHIPPING PAPERS

(a) Carriers must not accept for transportation nor transport any hazardous material subject to the regulations in this chapter unless that article is described on the shipping paper by the shipping name prescribed in Section 172.5 of this chapter and by the classification prescribed in Section 172.4 of this chapter. A further description not inconsistent therewith may be included. Abbreviations must not be used. The total quantity by weight, volume, or as otherwise appropriate, must be shown.

(b) Where the regulations (except Sections 173.402 and 177.815 of this chapter) exempt the packages from labeling the exemption must be indicated by the words "No Label Required" immediately following the description on the shipping paper.

(c) The driver of each motor vehicle transporting hazardous materials must have in his possession a copy of the shipping paper showing the information required in paragraphs (a) and (b) of this section.

(d) Each carrier offering or delivering for rail transportation any loaded motor vehicle, trailer, semitrailer, or container containing hazardous materials must show on the shipping paper the information required in paragraphs (a) and (b) of this section, the description of the vehicle or container, and the kind of placards applied.

## 177.819 CERTIFICATE

(a) Carriers must not accept for transportation nor transport any hazardous material subject to the regulations in this chapter unless it has been certified by the shipper, using the following certificate which must be signed by the shipper:

This is to certify that the above-named articles are properly classified, described, packaged, marked, and labeled, and are in proper condition for transportation, according to the applicable regulations of the Department of Transportation.

However, preprinted shipping papers bearing previously authorized certificates may continue to be used until existing stocks are depleted, but not after June 1, 1968.

(b) Shipper certification is not required for shipments to be transported by the shippers as a private carrier except for shipments which are to be re-shipped or transferred from one carrier to another, or for bulk shipments in cargo tanks supplied by the carrier.

## 177.841 POISONS

(See also Section 177.834 (a) to (k).)

(a) **Arsenical compounds in bulk.** Care shall be exercised in the loading and unloading of "arsenical dust," "arsenic trioxide," and "sodium arsenate," allowable to be loaded into sift-proof, steel hopper-type or dump-type motor vehicle bodies equipped with water-proof, dust-proof covers well secured in place on all openings, to accomplish such loading with the minimum spread of such compounds into the atmosphere by all means that are practicable; and no such loading or unloading shall be done near or adjacent to any place where there are or are likely to be, during the loading or unloading process assemblages of persons other than those engaged in the loading or unloading process, or upon any public highway or in any public place.

(2) Before any motor vehicle may be used for transporting any other articles, all detectable traces of arsenical materials must be removed therefrom by flushing with water, or by other appropriate method, and the marking removed.



(b) **No class A or class C poisons in cargo tanks.** No dangerous poison, class A, or any tear gas or irritating substance, class C, may be loaded into or transported in any cargo tank.

(c) **Class A or class C poisons.** It shall not be permissible to transport class A or class C poisons if there be any interconnecting means of any character between the containers.

(e) Material marked as known to be poison (class A or B) must not be transported in the same vehicle with material which is marked as or known to be foodstuffs, feeds, or any other edible material intended for consumption by humans or animals.

### 177.853 TRANSPORTATION AND DELIVERY OF SHIPMENTS

(a) **No unnecessary delay in movement of shipments.** All shipments of hazardous materials shall be transported without unnecessary delay, from and including the time of commencement of the loading of the cargo until its final discharge at destination.

(b) **Delivery at destination.** Shipments of hazardous materials which are refused by the consignees, or which *can not be delivered within 48 hours after arrival at destination, must be promptly disposed of* (1) by return to the shipper, if in proper shipping condition, or (2) by storage, provided a suitable storage place for such articles is available, or (3) by sale, or (4) when necessary to safety, by destruction: *Provided*, that charged electric batteries may be held for 30 days after arrival at destination, pending delivery or disposition.

### 177.854 DISABLED VEHICLES AND BROKEN OR LEAKING PACKAGES; REPAIRS

(See also FORBIDDEN ARTICLES, Section 177.821)

(a) **Care of lading, hazardous materials.** Whenever for any cause other than necessary traffic stops any motor vehicle transporting any hazardous material is stopped upon the traveled portion of any highway or shoulder thereof, special care shall be taken to guard the vehicle and its load or to take such steps as may be necessary to provide against hazard. Special effort shall be made to remove the motor vehicle to a place where the hazards of the materials being transported may be provided against. See sections 392.22 to 392.26 inclusive, of this chapter, for signals required to be displayed on the highway.

(b) **Disposition of containers found broken or leaking in transit.** When leaks occur in packages or containers during the course of transportation, subsequent to initial loading, disposition of such package or container shall be made by the safest practical means afforded under paragraphs (c), (d), and (e) of this section.

(c) **Repairing packages.** Packages may be repaired when safe and practicable, such repairing to be in accordance with the best and safest practice known and available.

(d) **Transportation of repaired packages.** Any package repaired in accordance with the requirements of paragraph (c) of this section, except as provided in sections 177.855 (c), 177.856 (c), and 177.858 (b), may be transported to the nearest place at which it may be safely disposed of only in compliance with the following requirements:

(1) The package must be safe for transportation.

(2) The repair of the package must be adequate to prevent contamination of or hazardous admixture with other lading transported on the same motor vehicle therewith.

(3) If the carrier is not himself the shipper, the consignee's name and address must be plainly marked on the repaired package.

(e) **Disposition of unsafe broken packages.** In the event any leaking package or container cannot be safely and adequately repaired for transportation or transported, it shall be stored pending proper disposition in the safest and most expeditious manner possible.

#### **177.856 ACCIDENTS; FLAMMABLE LIQUIDS**

(b) **Prevent leakage from spreading.** Whenever any flammable liquid is escaping from a container, all practical means shall be taken to prevent such liquid from spreading over a wide area, from flowing into sewers and streams, and from becoming ignited.

(c) **Disposition of contents of cargo tank when unsafe to continue.** In the event of a leak in a cargo tank of such a character as to make further transportation unsafe, the leaking vehicle should be removed from the traveled portion of the highway; and every available means employed for the safe disposal of the leaking liquid by preventing, so far as practicable, its spread over a wide area, such as by digging trenches to drain to a hole or depression in the ground, diverting the liquid away from streams or sewers if possible, or catching the liquid in containers if practicable. Smoking and the lighting of cigarettes, cigars, or pipes in the vicinity is prohibited, and fires or flames in the vicinity of the leaking cargo tank must be extinguished.

(e) **Transportation of leaking cargo tanks.** A leaking cargo tank may only be transported the minimum distance necessary to reach a place where the contents of the tank or compartment may be disposed of with safety. Every available means must be utilized to prevent the leakage or spillage of the liquid upon the highway.

#### **177.860 ACCIDENTS OR LEAKAGE; POISONS**

(a) **Accident to vehicle; warnings; no sparks of flame.** In the event of an accident involving any motor vehicle transporting any poison which is flammable, noxious, or toxic, every available means shall be employed in the protection of persons or property or in the removal of hazards or wreckage, from congregating in the vicinity; such means shall also be employed to prevent smoking, to keep flame away, to safeguard against the aggravation of the hazard present, and to warn other users of the highway. Care shall also be taken to prevent any poison, whether flammable or nonflammable, from contaminating streams or flowing or being spilled into sewers, and poison in powdered form from being scattered by wind. (See also section 177.814.)

(1) **Leakage.** A vehicle which has been used to transport material marked as or known to be poison (class A or B) must be inspected for contamination before reuse. A vehicle which has been contaminated must not be returned to service until such contamination has been removed. This subparagraph does not apply to vehicles used solely for transporting such poisons so long as they are used in that service.

(b) **Leaking cargo tanks.** In the event of leakage of liquid from any cargo tank or any compartment thereof used for the transportation of any poison which is also flammable, or which would come also within the definition of a flammable liquid, or of any gas or combination of gas and liquid, or any poison which would come within the definition of a compressed gas, the requirements shall be the same as those set forth for flammable liquids and compressed gases. In addition, all possible care shall be taken to warn bystanders or other users of the highway against the hazard of inhaling vapors or coming in contact with the poison.

#### **177.870 REGULATIONS FOR PASSENGER-CARRYING VEHICLES**

(f) **Poisons on passenger-carrying vehicles.** No motor carrier may transport any extremely dangerous poison, class A, any tear gas or irritating substance, class C, any less dangerous poison, class B, which is a liquid, or any paranitraniline, in any amount, in or on any bus while engaged in the transportation of passengers; or any less dangerous poison, class B, which is other than a liquid, in any amount exceeding an aggregate of 100 pounds gross weight in or on any such bus.

**Appendix D**

**EMERGENCY TELEPHONE NUMBERS**

**(24-Hour Monitoring)**

**PESTICIDES, CLASS B POISONS**

National Agricultural Chemicals Association  
Pesticide Safety Team Network  
Cincinnati, Ohio

Telephone: 513-961-4300

Types of Assistance: Can furnish personnel, equipment and expertise for cleanup and decontamination.

**CHEMICAL EMERGENCIES**

Manufacturing Chemists Association  
CHEMTREK (Chemical Transportation  
Emergency Center)  
Washington, D. C.

Telephone: 800-424-9300  
(WATTS LINE - Toll Free)

In Washington, D. C. only  
483-7616

Types of Assistance: Technical expertise in handling emergency. Can also provide additional emergency numbers to contact for emergencies other than chemicals; when in doubt, contact this number.

**RAILROAD INCIDENTS**

American Association of Railroads  
Bureau of Explosives  
Washington, D. C.

Telephone: 202-293-4000

Types of Assistance: Hazardous materials incidents involving trains.

**DEPARTMENT OF TRANSPORTATION IMMEDIATE NOTIFICATION OF HAZARDOUS  
MATERIALS INCIDENTS (49 CFR 171.15)**

U. S. Department of Transportation  
Washington, D. C.

Telephone: 202-426-1830

# **RULES FOR WORKERS IN WAREHOUSES WHERE STORAGE OF HAZARDOUS CHEMICALS NECESSITATES AVAILABILITY AND USE OF PROTECTIVE CLOTHING AND SAFETY EQUIPMENT**

by

*H. Moss, Jr.  
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For the most part, plant storage areas fall within the manufacturing safety rules and are amply covered by other speakers on safe operating practices. My remarks are therefore directed at the commercial public warehouse operation. Within my area of responsibility is the storage of our products including hazardous materials at as many as fifty locations. One of our prime concerns has been the safety of workers where our products, mainly pesticides, are stored.

In actuality, the storage of pesticides is simplified somewhat as compared to commercial class B poisons or somewhat less toxic chemicals. In the case of pesticides, at least two types of labels must appear on all poisons. These are the product labels registered with the Environmental Protection Agency and the poison shipping label prescribed by the U.S. Department of Transportation. Extreme care is taken to correctly describe the product, the hazards involved, the methods to be used in handling the product, and what to do in case of poisoning. The product labels of highly toxic products carry the word POISON and the SKULL AND CROSSBONES symbol.

The chemical name and ingredient statement must be shown on all pesticide labels. As a result of the duality of labels, publicity, and education, workers and the public show a more healthy respect for a chemical described as a pesticide than perhaps they would for a commercial chemical of equal or greater toxicity.

When first approached to discuss rules for workers in warehouses, I scratched my head, did some research to determine (a) who the real experts were and (b) what written material specifically covered this subject area. I could find no real public experts nor very much published material on this subject. The reasons for this are quite simple.

To understand my last statement, let's for a moment examine just what a public warehouse operation is all about. A public warehouse man is a private business entity which is in business to caretake another's property for a fee. Services can include, in addition to simple time storage, paperwork involved in receipt of merchandise and the handling of shipping which may include transportation. Other services may include:

- Order processing and inventory control
- Traffic management,
- Refrigeration or other temperature controls
- Cooperage

The public warehouseman may do business with many diverse customers. One warehouseman lists almost 200 different customers including manufacturers of chemicals, pharmaceuticals, appliances, metals, transportation equipment, electronics, paper, food processors and merchandisers, retailers, and government agencies. It is no small wonder that the safety problems for workers is unique. For obvious reasons, there is no single solution to their problems.

In truth, the public warehouseman is totally dependent on the knowledge and expertise which his customers must impart to the warehouseman in the way of precautionary information or, when needed, technical assistance.

In our case, we have supplied each of our warehouses with safety information and manuals, and also, perhaps uniquely, a complete set of safety equipment.

The safety equipment contained in four 55-gallon drums on a single pallet includes:

1. Two pairs of coveralls
2. Two pairs of rubber gloves
3. Two pairs of rubber boots
4. Two full-face gas masks
5. One 50-pound bag of fullers earth
6. Ten 1-pound cans of household lye
7. One 3-pound box of household detergent
8. One square-end steel shovel
9. Three short handled straw brooms



10. One 5-gallon steel open-head pail
11. One drum bung wrench
12. One drum faucet
13. One 1-3/8" open-end wrench
14. Two multi-meter, Model Mr 50, drum pumps with flex attachment for a 55-gallon drum, plus two extra lengths of tubing
15. One 30-foot length of 1/2" Polyethylene tubing
16. Two 55-gallon return drums with nonremovable heads
17. Two 55-gallon disposal drums with removable heads, also used for storage of clean-up and safety equipment.

The masks in the above kit assembly protects the wearer against gases, dusts, fumes, mists and vapors in concentrations up to 20,000 parts per million (2%). The canister life is 1/2 hour at a 2% concentration.

The mask-canister combination must not be worn in an oxygen deficient atmosphere. Sixteen percent oxygen is the minimum that can be tolerated. An oxygen deficient atmosphere might exist in a tank truck or a closed vessel, a type of usage that should not be encountered by the warehouseman.

The palletized kit is sent to every warehouse as soon as we enter into a contract and proceed to store materials. At the same time storage manuals and safety data are also forwarded.

The kits are inspected by my own personnel on a fairly regular schedule and the warehouseman is told to notify us immediately if any item in the kit is expended and a replacement is immediately sent from our plant. Records are kept so that the gas mask canisters are replaced before the expiration date.

While it is implied at the time of placement that the kit, which is valued at approximately \$300, is for usage involving our own materials, we issue no express prohibition against the usage with competitors hazardous materials. We do recognize that the warehouseman does "raid" the kit for use with other than Shell products. Other than the fact that he is less likely to report depletion of the kit when raiding is involved — we usually discover this on inspection — our view is that safety cannot wear a brand name nor are we in a position to insist that all manufacturers install complete safety kits in warehouses.

An ounce of prevention is worth a pound of cure. The key to safety as it pertains to storage or for that matter any other step in the distribution chain is a superior containment program. While there is no such thing as a foolproof container, much grief can be avoided by doing a quality job where it really counts. Incidentally, it is surprising how effective the use of color is in avoiding product mix-ups in warehouses.

Safe pesticide storage or "warehousing" is a matter of prime importance. There are no government rules or regulations specifically on warehousing. Pesticide manufacturers as well as the National Agricultural Chemicals Association do publish storage guidance with respect to the several classifications of pesticides. The only general or nonspecific collection of rules for safe pesticide storage, known to me, was prepared by Cornell University in Supplement II of its *Northeast Pesticide Information Manual*. Chapter V of this Supplement is quoted as follows:

"Rules for safe pesticide storage: Identify pesticide storage with prominent waterproof signs over each entrance, including windows, if present, and on all sides of building. Keep locked when not in use. Inform police, fire department, and public health officials in writing of the location and layout of the storage, types of materials stored, and hazards involved. Leave phone numbers of persons responsible for storage with fire chief. Fire companies should map the locations of pesticide chemical storages in their respective areas. Inform local physicians and hospital of potential hazards and be sure they know how to treat and that antidotes are on hand."

The U.S. Public Health's *Clinical Handbook on Economic Poisons* should be available. Antidotes should include an adequate supply of atropine sulfate and 2-PAM (Protopam Chloride). Post list of chemicals



(organophosphates, carbamates, herbicides, chlorinated hydrocarbons, flammable solvents, etc.) on outside of building, along with storage plan. Obtain desirable fire-fighting equipment, familiarize yourself and your help with its operation. Be sure it works. Keep pesticide containers, particularly glass, away from windows and out of sun so they will not be subject to heat and ignition. Do not store partly empty containers of pesticides containing chlorates. Keep combustibles away from steam lines and heat. Read label for information on flammability and store accordingly. Store highly toxic pesticides in one area. Store herbicides separately from other pesticides to prevent cross-contamination and to prevent errors in choice of material. Dispose of unlabeled pesticides. Treat them as highly toxic. Keep a quantity of hydrated lime on hand for detoxification of spills."

For protection of the worker and, of course, the public, there are certain operating, and what I prefer to call good housekeeping practices that should be adhered to in addition to those recommended in the Northeast Pesticide Information Manual. These include:

- Restricted smoking both from a toxicology standpoint as well as fire hazard.

- Segregated storage; foodstuffs; pharmaceuticals; clothing; absorbent materials such as paper goods, including napkins, paper plates, etc.; and hazardous materials should be kept in separate storage areas. This rule must be applied vertically as well as laterally. More than once I have seen fine segregation laterally only to come across toxic materials on the second floor of a multi-story warehouse with foodstuffs on the floor below.

- Train the warehouse worker to be safety conscious, particularly fork lift operators who are capable of wrecking havoc with any container.

- Notify the safety kit supplier as soon as any item in the kit has been expended. Keep the kit in a readily accessible place.

**Read the labels.**

- Remove contaminated clothing immediately and insure disposal, shoes in particular.

- Have available shower and eye wash facilities which are frequently tested, and use them when in doubt.

- Keep emergency telephone numbers including emergency teams, medical and poison control centers, police, and fire readily available and accessible.

- Inspect containers of poison pesticides for leaks before handling.

- If a leak or spill does occur, keep people away and report it through the emergency system immediately.

- After hazardous materials have been moved, inspect the area for contamination.

- Major pesticide manufacturers normally provide information on safe storage and handling as well as on site decontamination kits at their own and public warehouse location.

The exception to my statement, on the absence of regulations and an important one, is the local rules promulgated by fire departments pertaining to hazardous materials. Although these regulations vary considerably they do generally restrict storage to sprinklered and/or fire-proof buildings. The warehouseman's insurance underwriters may also effect certain safety conditions.

With respect to assistance rendered in the event of a pesticide spill endangering the general public, workers, and the environment, major manufacturers are, for the most part, prepared to assist immediately on notification of a spill of one of their products.

To better ensure that complete national coverage is provided by all major manufacturers, the National Agricultural Chemicals Association has sponsored membership participation in a national network of trained safety teams designed to minimize the risk arising from the accidental spillage or leakage of pesticide chemicals in the Class B Poison category. This network began operation on March 9, 1970. More than 38 teams were initially involved in the NACA program known as the Pesticide Safety Team Network, and more have since joined. There are similar emergency teams

sponsored by the Manufacturing Chemists Association called CHEMTREC, and other teams are sponsored by local groups such as the Western Agriculture Chemicals Association.

The point I wish to make about public warehouses is that it is unrealistic to expect that they are staffed or prepared for any extensive contact with exposed hazardous materials. With the possible exception of explosives, about which I know very little and for which there may be some special regulation, I say we must face the fact that public warehousemen have very little expertise in handling hazardous materials exposure. Unlike manufacturing plants staffed with technical experts, storage points of the type referred to here do not have the same level of staffing.

Do not misunderstand my intentions. I do not feel the system needs radical change. The public warehouseman has been doing a fine job and generally has conducted his business in a safe manner. What I am saying is that we need to recognize its limitations. In my own company we do recognize this limitation and assume the responsibility of providing the educational information and technical assistance. One of my staff spends approximately 50% of his time on the road visiting warehouses to review their procedures and to provide liaison, to report how the warehouse needs to improve its housekeeping, and where we can improve our own procedures. In addition, technical teams from our manufacturing plants have been at warehouse sites within a matter of hours when a location ran into trouble with a hazardous material.

In many ways the warehouses by their very nature, that is: their controlled environment, limited movement of product and the smaller number of people involved also makes the safety problem easier to administer than in the transportation industry.

## ATTITUDES AND PRACTICES OF PESTICIDE APPLICATORS REGARDING NECESSARY AND REGULAR USE OF PROTECTIVE CLOTHING AND SAFETY EQUIPMENT

by

*Mills L. Rogers*

*Rogers Entomological Service, Cleveland, Mississippi*

Over the past 20 years, I have talked to many tractor drivers, aerial applicators, farm managers, and other consultants concerning their attitudes toward safety and the practices they follow to insure safety. The bulk of my talk will be the results I have gathered from these sources.

I will now try to relate some of the attitudes and practices revealed by some of the applicators in my area. In the Mississippi Delta, we are seeing more and more use of the airplane for distribution of cotton insecticides. Probably two of the main reasons for their increase in popularity is due to the low cost of their application and also the speed at which they can apply the insecticide. While this is true, many of our small farmers still rely upon ground equipment in the early season. In the Mississippi Delta, most of our ground machinery consists of some type of highboy equipment. When highboys are used we find, in many cases, that the applicator is rushed to get through and, consequently, does not observe safety precautions. The use of gloves is very seldom seen, and, in many cases, the driver is doing the mixing and loading. I have frequently observed that in a small operation made up of a father-son combination safety precautions seem to be practiced more thoroughly than when day laborers are used. It may be pointed out that safety precautions are not practiced as thoroughly in the early cotton season as compared to the later cotton season simply because the type of insecticides used in many cases are not as toxic as compared to those used in later seasons.

The larger farmers in many cases use aerial applicators through the growing season. When this practice occurs, the safety precautions lie mainly in the hands of the aerial applicator rather than with the farmer himself. In many cases, the aerial applicator requires that the landowner furnish a man from his employment to load the plane. In this case, the aerial applicator usually informs the laborer of necessary safety procedures and furnishes him with safety clothing and equipment.

My experience with the aerial applicators is that they have done more to practice safety in their profession than any other type of applicator. It is my understanding that they have been warned by both the state and federal agencies several years ago that they must take immediate action to place in effect a new set of safety regulations. I have very close contact with all the aerial applicators in my area and have found them most knowledgeable of the hazards of all insecticides they apply. I found also that they take advantage of precautions that would more adequately protect their ground crew. Those of us serving as consultant entomologists are frequently in a cotton field when the aerial applicator is ready to commence his poisoning. We have observed that they are extremely cautious about putting any insecticide out with us or any farm laborers present in the field. Most of the applicators have respirators and antidotes in their planes at all times. I say again the aerial applicators observe safety rules and regulations as much if not more than any other group of applicators I have observed.

I would like also to talk about the attitudes and practices of another group related to applicators, the consultant entomologists. In the Mississippi Delta, approximately 70% of our farms are being scouted by consultants. In the entire state, approximately 600,000 acres of cotton is scouted in some way or the other. The professional entomologists and their helpers are probably involved in contact with the cotton plant itself more so than any other group during the growing season. We are extremely cautious of fields that have been poisoned. Most of us keep an open communication between ourselves and the farmer as to when he poisoned and when he gets off schedule. In my talking with other entomologists, I find that very few of them wear any type of short pants, which includes Bermuda shorts. All the entomologists that I have talked with require their scouts to wear long trousers, especially when the cotton gets over 14 inches in height. Some entomologists require that all the scouts wear shirts the entire season. Others permit the removal of the shirt when the cotton is below waist level. In the late season, the presence of dew in

the early morning has caused some concern. Some entomologists require the presence of rubber trousers, while others practice the changing of clothes when the dew disappears. I have found that not all the consultant entomologists have first-aid kits or any form of antidote present in their vehicles. We have a practice of carrying not only these but also salt tablets, snake-bite kits, and plenty of water.

The other group that I would like to discuss is the pest control and termite applicator. I would like to say in the beginning that the National Pest Control Association (NPCA) has done an excellent job in informing us of safety equipment available and its uses. The attitude of most of us is that safety is of utmost importance in this field, especially in the termite work where the use of electric drills is present. I think that the larger companies are more safety-conscious than our smaller companies. In the smaller companies, especially the one-man operator companies, short cuts may be taken that detrimental to his best welfare. I think most of the operators in my area wear the necessary gloves, aprons, and respirators while mixing the concentrate. If there is one area in which the pest control operator is lacking, it is in not using respirators, or dust masks, when the serviceman applies the diluted insecticide. Many times it is inconvenient to take the time to use these safety precautions. In our area, we have become very conscious of the dangers of drills and skill hammers in termite work. We have had no known accidents in our area with these units, but we have seen several deaths among plumbers and electricians. Our attitude toward the practice of the using of drills under the house is one of extreme caution.

I have corresponded with several state agencies concerning statistics pertaining to agricultural and other chemical sicknesses or mortalities. I have talked with Dr. Frank Gilmore, School of Pharmacy, University of Mississippi. Dr. Gilmore is chairman of the Department of Medicinal Chemistry. This department takes calls from anyone in the state concerning insecticidal poisoning and makes necessary recommendations to doctors for treatment. Telephone numbers are posted at hospitals and doctors' offices throughout Mississippi. This department strongly encourages all doctors to send all insecticidal poisoning reports to them. I am sure you are probably aware that not every insecticide sickness is reported to them, but a large portion of them apparently are. Their records show that in 1970 they had received reports of eight chlorinated hydrocarbon poisonings, five organic phosphate poisonings, four carbonate poisonings, and three pyrethrin poisonings. In 1971, they had twelve chlorinated hydrocarbon poisonings, six organic phosphate poisonings, one carbonate poisoning, and no pyrethrin poisonings. There was an increase in 1971, involving chlorinated hydrocarbons.

Their report shows that in the state of Mississippi in 1970 they had thirteen calls dealing with pest control insecticides and eleven in agricultural pesticides. Also, in 1971 they had ten calls from pest control insecticides and seventeen from agricultural pesticides. Among the questions that I asked Dr. Gilmore was, "Is your yearly report distributed to anybody other than medical doctors?" He stated that to his knowledge, no one receives information as to which insecticides are getting the most calls, other than the medical profession. I think that it would be most advisable for us who are in the field to have a knowledge of which insecticides are causing human emergency illness. He also stated that his records show that there was not a single death in 1970 or 1971 that could be contributed to agricultural or household-related insecticides.

I contacted the Mississippi State Board of Health concerning any information they might have about insecticidal poisoning. The only information they had in the state was concerning the number of mortalities from pesticides and insecticides. The following is a report of the number of deaths they had recorded: 1968-0; 1969-2; and 1970-2.

Upon checking with the Mississippi State University, I found out that there is a project in progress at our USDA Mississippi Delta Branch Experiment Station concerning insecticidal poisoning. This contract is from the Community Study of Pesticides and is under the supervision of Dr. Ben Barrington, Biochemist, Mississippi State University.

This service is being carried on by Mr. Kit Ginn, who is the field investigator. Their reports concern only three Delta counties which are Bolivar, Sunflower, and Washington. Their reports show that from July of 1967 until January of 1972, these three counties have had an average of 10 pesticidal poisonings per year. During this same period, there have been two deaths reported in these three counties. One was concerning an alcoholic who drank methyl parathion and DDT and the other was dealing with a child who got ethyl parathion in her mouth. In 1970 there were six sicknesses recorded from an instance where all six persons became ill in handling treated cotton seeds. These reports are accumulated from county agents, extension service personnel, and doctors' reports. Their main problem is in determining whether or not exposure to pesticides has a chronic effect on human health.

I think it would be only fair to mention several instructional agencies that have kept us abreast in safety procedures. Many of our chemical companies hold meetings in which safety is emphasized. They also, in many cases, supply us with charts indicating the LD-50 on many chemicals.

Both our State Plant Board and extension service offer special workshops in our state several times a year. Safety and chemical hazards are, in most cases, emphasized heavily. Our state is in the process of licensing cotton



consultants, which will be put into effect during this year. These two agencies have already had two meetings pertaining to cotton consultants. One of the meetings had part of the program designated to the hazards and dangers of agricultural insecticides.

Since January of 1971 the State Plant Board has trained one hundred and fifty pest control operators and service men in a twenty-week course. This course emphasizes chemical hazards and safety. These three schools trained approximately 60% of the pest control operators and servicemen in the areas the course was offered.

Our extension service with headquarters at Mississippi State University is very much involved in providing workshops, one-day seminars, and newsletters pertaining to safety.

Once again let me mention our National Pest Control Association. For the man in the pest control business, this organization has done an excellent job in providing its members with information pertaining to safety.

In conclusion, I would like to say I know of none of my competitors in the cotton consulting business who have ever been hospitalized due to agricultural insecticides poisoning. I do not know of any of my competitors in the pest control business who have been hospitalized due to insecticidal poisons. In my business we have employees who have occasional headaches and sore throats as in any other business.

As I said in the beginning, this is my twentieth year in the business. I try to see my doctor each year for an annual check up. My health is excellent; I have medical reports dating back several years as proof. I am living proof that, if a man practices good safety rules in handling insecticides, these insecticides are not a hazard to his health. When the insecticides are properly used, the chances of emergencies and illness are reduced and eliminated.

My generation is the first to grow up with these powerful agricultural and pest-control chemicals. It might be prudent in the future for anyone who makes insecticide recommendations to be thoroughly trained and regulated.

I would like to point out that training sessions have been vital to the report that I have been able to convey. This report can be marred any minute, and certainly will be marred any time that persons dealing in insecticides' application or their recommendations fail to be prepared.



## PESTICIDE WORKER ACCIDENTS – WHAT'S HAPPENING

by

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The National Safety Council welcomes the challenge to place the pesticide worker accident problem in perspective. I say that it is a challenge because the information available to us as well as to the rest of the industry is woefully inadequate. We have little information that is specific in the area of mortality from agricultural pesticides and even less on the morbidity that results from worker contact while preparing, mixing or applying agricultural or household pesticides.

Those of us who see field operations are startled at the apparent disregard for the recommendations for the use of personal protective equipment. The Farm Conference of the National Safety Council is now engaged in surveying farmers to determine their actual understanding of pesticide and other farm hazards, their knowledge of available personal protective equipment, the equipment they have available and the actual use made of this equipment. This survey will include the head and foot protection as well as respiratory, eye and hand guarding normally used around chemicals. The results of this survey will be published when available.

### **Pesticide Accident Data Search**

When this assignment was accepted it was hoped that a cross section of detailed accident reports could be obtained and analyzed to determine the deficiencies in personal protective equipment use and show just when such equipment is needed by workers handling pesticides.

Our first finding was that most readily available accident reports involved field re-entry or youthful victims. These are serious problems but not within the scope of this conference.

A survey form was developed from the standardized accident supplemental report form which is being used to report any "chemical" accident in the National Safety Council's state accident surveys.

Copies of this form were sent to state extension safety specialists, a number of entomologists, and several pesticide industry people. The cover letter asked for comments on the form itself as well as accident information. We received many valuable suggestions.

Relatively few accident reports were received. Several safety specialists and extension entomologists reported that they were unaware of *any* recent accidents in their states. Any discussion with farmers or physicians in rural areas will document the fact that pesticide related accidents are happening but they are being tolerated or treated without notation by the local physicians.

Literature covering the pesticide accident situation was searched for cases and statistics. Most studies reported experience in regions, even counties, and fail to give an overall picture of the pesticide accident situation. Many of these studies date back to the early and mid 1960's when the organophosphates were first coming into general use in agriculture.

For instance, the 1968 study by Drs. Hatcher and Wiseman (1) of the situation in the lower Rio Grande valley indicates that all but three out of the 118 illnesses were work related. Workers re-entering the field accounted for 23 poisonings, all occurring in the same field at the same time.

During a four year period ending in 1967, Reich et al.(8) reported 25 out of 133 pesticide poisoning cases in Dade County, Florida as being occupational. In this list of 133 cases were included 37 suicides, 8 intended homicides and 2 were unclassified. Sixty-one cases were due to strictly accidental contact with pesticides such as by playing children or ingestion thinking it to be another substance.

The state of California has done a consistently fine job of keeping track of agricultural accidents in general and chemical accidents in particular over a number of years. California has a compulsory women's compensation law that

(1) Numbers in ( ) refer to approved references.

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requires attending physicians to report accidents to the state before claims can be paid. In the 1969 report, Occupational Disease in California Attributed to Pesticides and Other Agricultural Chemicals,<sup>(9)</sup> the following table summarizes fatalities from pesticides to all workers, both field and pesticide handling. It also includes structural and household contract workers.

#### ACCIDENTAL DEATHS DUE TO PESTICIDES AND OTHER AGRICULTURAL CHEMICALS IN CALIFORNIA, 1951-1969

|                              |     |
|------------------------------|-----|
| Total (for 19 years)         | 163 |
| Children                     |     |
| Arsenic                      | 48  |
| Organic Phosphates           | 17  |
| Other Agricultural Chemicals | 27  |
| Workers (Occupational)       |     |
| Organic Phosphates           | 16  |
| Methyl Bromide               | 7   |
| Other Agricultural Chemicals | 13  |
| Other Adults                 |     |
| Arsenic                      | 17  |
| Other Agricultural Chemicals | 18  |

Source: State of California, Department of Public Health, Death Records.

If the data summarized above were for a few of the more recent years, it could be safely assumed that the organic phosphates would be more heavily involved. For instance, in the Reich, study<sup>(8)</sup> organic phosphates were implicated in 96% of the occupational poisonings.

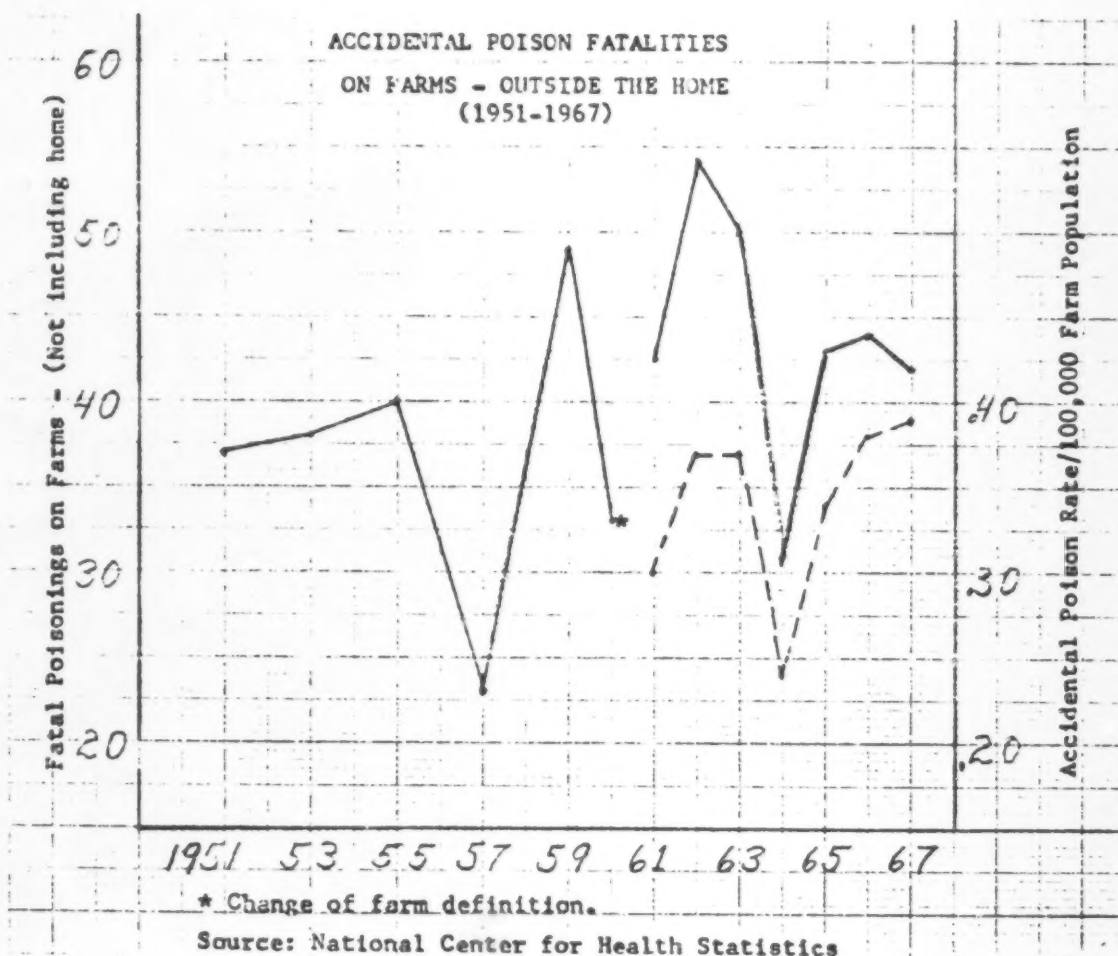
In areas away from the intensive fruit and vegetable farming regions, pesticide poisoning takes on a broader, general picture. Dr. Keith Long et al, in their 1966 study of 155 farmers in Iowa,<sup>(2)</sup> found that farmers who use any pesticide extensively tend to use several chemicals for both crop and livestock production. Some of these exposures may be of minimal risk despite quantities handled reaching multiple ton proportions. This diminution of risk comes from use in the open air, granular formulations and one-man handling.

On the other hand, when two or three workers start spraying cattle in a corral, exposure can be extreme and sudden due to unexpected actions of the animals and the close proximity of workers to the chemicals being applied. Although Long found bodily function factors common to the users of chemicals that were not present in non-users, he could not find correlation to the amount of pesticide chemical used.

Farm operators and their full-time employees may well have a better knowledge of the hazards of chemicals than we suspect. This would seem to apply to other pesticide workers in plants and working with pest control contractors. This theory is advanced by Bohlen, Beal and Lindgren<sup>(3)</sup> in their 1964 Iowa study on farmer behavior related to pesticides. These sociologists questioned a statistical sample of farm operators as to their knowledge, use, attitudes and information sources. They found that the sample was able to answer safety precaution questions with a 84.4% accuracy while general knowledge questions were answered correctly only 70.6% of the time. Less than 50% of the questions relating to the specific utilization of herbicides or insecticides were answered correctly.

#### Trends in Pesticide Poisonings

Other than the National Center for Health Statistics tabulations of "Nontransport Deaths from Accidents on Farms," we have no national profile on pesticide poisonings. This listing does not differentiate between pesticides and any other toxic substance that might be harmful. It covers only farm residents but does limit the place of injury outside the home. Here in graph form are their figures from 1951 through 1967, the last year for which such figures will be available because of a change in coding of death certificates. The broken line represents a crude population rate against poisonings.



Keil, Sandifer and Gadsden<sup>(4)</sup> reported, that in 1969, 667 South Carolina physicians replying to a questionnaire reported seeing 572 cases of pesticide poisoning. None of these were fatal. Despite an increased use of pesticides, the doctors felt that there had been no increase in cases. An earlier report from South Carolina<sup>(11)</sup> indicates over 60% of the pesticide fatalities in that state over a ten year period were children under 5 years. The median age of these victims was 2.5 years. Most of the remaining victims, according to Mr. Keil's reports, are field workers exposed by field re-entry.

The February, 1971 issue of *Texas Medicine*<sup>(5)</sup> reports a decrease of reported pesticide poisonings in the lower Rio Grande valley from 118 in 1968 to only 18 in 1969. This drastic reduction is credited by Drs. Smith and Wiseman to a combination of favorable situations beginning with lower insect populations, use of a less toxic insecticide and noticeably better safety practices by the pesticide workers. The following chart shows the occupational involvement of the worker classes for the two years being compared.

FIGURE II

Occupational status of patients poisoned with pesticides.

| Category                        | Cases |     |      |     |
|---------------------------------|-------|-----|------|-----|
|                                 | 1968  |     | 1969 |     |
|                                 | No.   | %   | No.  | %   |
| Aerial applicators              |       |     |      |     |
| Pilots                          | 8     | 7   | 0    |     |
| Loaders                         | 44    | 37  | 0    |     |
| Flaggers                        | 8     | 7   | 1    | 7   |
| Mechanical workers              | 13    | 11  | 1    | 7   |
| Formulators                     | 6     | 5   | 5    | 33  |
| Growers, farm workers           | 33    | 28  | 3    | 20  |
| Pest control operators          | 0     |     | 2    | 13  |
| Miscellaneous (welder of drums) | 5     | 4   | 1    | 17  |
| Children                        | 1     | 1   | 2    | 13  |
| Total                           | 118   | 100 | 15   | 100 |

(Source: Texas Medicine, Feb. 1971)

#### Accidents and How They Happen

As Mr. Rogers has told us this morning, professional pest control contractors seem to experience very few serious mishaps in the handling of chemicals. Donald L. Suggett, president of Soilserve, Inc., Salinas, California, testified before the Select Subcommittee on Labor, Committee on Labor and Education, House of Representatives in San Francisco on November 21, 1969. (6) Mr. Suggett described his business which employs 16 field scientists and 100 equipment operators using a combination of 115 pieces of applying equipment. This staff services over a quarter million acres per year.

In the previous year, Soilserve, Inc. had no serious poisonings. They did report two cases of skin irritation, five cases of organophosphate symptoms which were removed from exposure without lost time or medical treatment, one organic phosphate spill resulting in two days lost time and one fumigant burn caused by failure of the operator to wear the protective boots provided.

Aerial applicators account for a large portion of our pesticide application activity. They also contribute to the aircraft accident rate at a pace only slightly lower than pleasure flying. The accident rate for aerial applicators is three times as high as other forms of commercial flying such as air taxi. (7) In the exhaustive study of these accidents made by Dr. Reich and Major Brener, 69% of the fatal crashes were found to be connected with (not necessarily caused by) abnormal post-mortem test results. Alcohol was involved in two cases, carbon monoxide in three and depressed cholinesterase level in 16 test pilots. Cholinesterase was depressed in half of the examinations conducted.

Dr. Irma West (11) reports an aircraft accident that resulted from engine trouble but became subsequently related to pesticide safety. The plane nearly executed a safe forced landing but was damaged enough to rupture the dust bin containing TEPP. The pilot was generally covered with the dust as he emerged unhurt from the carft. He asked approaching field hands for a drink of water and within a few minutes was violently ill. He expired before reaching the hospital. An even more macabre twist developed when the mortician had to be treated for poisoning from handling the pilot's body.

#### Accident Analysis

There are three recognizable levels of accident reports. *First Level Reports* give us the number of persons involved, the primary agent involved and perhaps, some information on the time and place of the accident. National Safety Council State Accident Surveys and summaries from the Poison Control Center are examples of this level. These reports are useful in scanning the field for factors that might be helpful in general poison prevention programming.

*Second Level Reports* give the above information plus an account of the victim's activity, mechanical defects, if any, and general environmental factors that might have entered into the accident situation. When enough of these



more complete reports are accumulated on a given type of accident, an analysis of the factors contributing to the accidents can be compared and countermeasures may be derived that would apply to the class of accident.

*Third Level Reports* are in-depth studies of individual accidents by trained investigators, sometimes working in interdisciplinary teams. This form of investigation can often determine causes and either operator or equipment deficiencies that would be overlooked by the casual observer. Cost of this type of investigation tends to limit its use to extremely complex and high mortality potential accidents. Without a broad sample such detailed studies may find minute problems while overlooking the more obvious accident countermeasures that could be put into effect against the more numerous accident situations.

The following accident cases *do not* constitute a valid sample of the pesticide-related incidents in this country. They are presented with varying degrees of informational incompleteness to illustrate some of the situations that can and do confront pesticide users in agricultural and commercial operations. The total lack of sample stratification makes tabulation of the total accidents reported less than meaningful except for broad overview.

| Source* | Account of the Accident**                                                                                                                                                                                                                           | Countermeasure Suggested                                                                 |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------|
| S       | Twenty year old male farm worker mixing parathion for spraying. He dropped the can of concentrate causing the liquid to splash into his face and upper torso. He failed to mention the spill and did not remove contaminated clothes.               | Protective clothes during mixing of concentrate. Better training on emergency action.    |
| S       | Farmer, 25 years old, was unplugging delivery tube of granular insecticide applicator. Sudden movement of the tube flicked granules into his eyes. Some loss of vision resulted.                                                                    | Eye protection while servicing.                                                          |
| S       | Farmer, about 55 years old, was picking up bags after application of Thimet soil insecticide. Was burning bags as suggested on the label. Was not concerned about hand contact or smoke. Experienced severe skin rash and organophosphate symptoms. | Protective hand wear and better training in disposal technique.                          |
| S       | Farm worker, 20 year old male, spilled nearly a quart of Di-Syston concentrate over his shoe. In the press of work, he neglected to remove the shoe. Became ill 36 hours later.                                                                     | Better training on emergency procedures. Protective clothing when handling concentrates. |
| S       | Loader-mixer, 16 year old male, was inconsistent in his use of protective equipment while handling organophosphates and became ill. Recovered when taken off the job.                                                                               | Better supervision of workers, especially the young and inexperienced.                   |
| S       | Commercial pest control operator, 55, became ill while applying a new ULV formulation of pyrethrins. He was wearing a respirator. It was later found to be the wrong type.                                                                          | Recommendation of proper personal protective equipment.                                  |

\*S - Indicates NSC survey form.

P - Indicates cases taken from publications which are included with the references.

\*\*All victims became ill. Recovery information is generally lacking.



| Source* | Account of the Accident**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Countermeasure Suggested                                                                                                                                                          |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| P-1     | Boy of 17 was spraying phosdrin when he spilled concentrate on his hands which he proceeded to wipe on his jeans. He washed routinely some time later. The jeans were worn the second day. Recovery took over a month.                                                                                                                                                                                                                                                                                         | Training in the handling of hazardous chemicals and enforced use of PPE with those chemicals justifying protection.                                                               |
| P-2     | A hand duster and highly toxic phosphate ester pesticide were used by a 16 year old boy on strawberries. He became ill at the end of the day and was taken to the doctor in the same contaminated clothing four hours later. Doctor did not recognize the poisoning symptoms until the child returned the next day with the label. The product later was found to be four times as concentrated as the label indicated. Doctor underprescribed treatment and child died.                                       | Use of proper equipment by supervised and trained people. Better control of labeling (case dates from 1963). Familiarization of physicians with poisoning symptoms and treatment. |
| P-3     | A young sprayer operator contaminated both the inside and outside of his gloves while mixing parathion. He proceeded to operate the rig and rested his gloved hands on his thighs while driving. He became ill suddenly, vomited into his respirator and was not able to remove it before aspirating the vomitus causing death.                                                                                                                                                                                | Training in decontamination and use of protective equipment. Training and supervision in handling of hazardous materials.                                                         |
| P-3     | Young swamper was in his first day when given the job of steam-cleaning and washing a crop dusting aircraft. He was not told of any hazard in the work. His clothes were seen to be thoroughly wetted. When he complained of not feeling well he was given two atrophine tablets and returned to work. He collapsed and died in the hospital several hours later.                                                                                                                                              | Training of new employees in the hazards of and protection needed when working around pesticide.                                                                                  |
| P-4     | Twenty three year old farmer entered hospital in serious condition after several bouts with illness. It was determined that he had made extensive use of Coumaphos and Korlan for spraying cattle, toxaphene for spraying hogs, Amiben and Thimet on corn. Just prior to hospitalization he had harrowed land treated with phorate. He ate several meals in a kitchen in which pest strips were hanging. He had been going with from 3 to 5 hours of sleep per night. He used no special protective equipment. | Education in need for and use of personal protective equipment. (This man, as proprietor, was not subject to supervision.)                                                        |

| Source* | Account of the Accident**                                                                                                                                                                                                  | Countermeasure Suggested                                                                                                                                 |
|---------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| P-4     | A 29 year old dairy farmer routinely used a fly spray containing 0.20% dichlorvos on his cows. After his second serious poison sickness episode it was found that the hand sprayer was leaky, exposing the man daily.      | Education for the recognition of chemical hazards. More warning on the product?                                                                          |
| P-7     | A gust of wind came along just as 33 year old farmer was about to pour Furadan granules into his planter. Several of these landed in his mouth. Immediately rinsed mouth with iced tea but became ill several hours later. | Minimal protective equipment such as a face mask would have prevented accident.                                                                          |
| P-7     | Forty days were required for recovery of a 40 year old farmer from the dermatitis received when he used bare hands to unplug nozzles on an atrazine sprayer.                                                               | Hand protection with dexterity enough to handle small parts.                                                                                             |
| P-7     | Dermatitis with severe pain resulted when a 50 year old farmer repaired a nozzle with his bare hands while spraying 2,4-D.                                                                                                 | Same as above.                                                                                                                                           |
| P-7     | A 23 year old mixer and loader became very ill after spilling a mixture of liquid chemicals on his skin.                                                                                                                   | Personal protective equipment, perhaps even an apron, could have prevented this injury.                                                                  |
| P-7     | Wind shifted while a farm employee was spraying a mixture of phosphamidon, parathion and Cyprex. Became very ill but recovered.                                                                                            | Personal protective equipment without reliance on wind to carry away toxic drift.                                                                        |
| P-7     | A 48 year old pilot was made ill and suffered blurred vision, a real hazard, when a hose ruptured spraying him with a mixture of Manzate and Guthion.                                                                      | Personal protective equipment and regular preventive maintenance of equipment.                                                                           |
| P-7     | Mixing parathion wettable powder with his bare hands proved fatal to a 23 year old formulator. Fatality appears to have been preventable as there is no indication of treatment for the poisoning.                         | Better in-plant supervision of safety procedures including use of personal protective equipment. Training to recognize poisoning symptoms by physicians. |
| P-7     | A hose ruptured in flight spraying a 27 year old pilot with methyl parathion.                                                                                                                                              | Personal protective equipment and regular preventive maintenance.                                                                                        |
| S       | Atropine treatment was required for a 35 year old salesman for a chemical company who handled a leaking container during a sales demonstration just outside the office.                                                    | More durable containers. Indication of when a leak has occurred. Training to emphasize the hazard of handling leakers.                                   |

| Source* | Account of the Accident**                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      | Countermeasure Suggested                                                                                                |
|---------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------|
| S       | A routine check of cholinesterase level revealed a 75% reduction in cholinesterase level of full-time applicator employee. He recovered quickly after removal from the exposure, suggesting that no PPE was being used.                                                                                                                                                                                                                                                                                                                                                        | Supervision of exposed workers. Use of personal protective equipment.                                                   |
| P-4     | After six months of poor health, a 51 year old manager of an experimental farm entered the hospital for treatment of kidney problems. Tests showed reduced cholinesterase activity and elevated concentrations of chlorinated hydrocarbon residue. History indicated frequent exposures to a wide variety of pesticides over a 30 year working time. In the period preceding hospitalization, he had experienced symptoms after using toxaphene and diazinon. He also used atrazine, malathion and aldrin without problems. Use of 2-chloro-N-isopropyl irritated his sinuses. | Use of protective equipment when handling hazardous chemicals. Education to encourage limited exposure where practical. |
| P-4     | The first exposure of this 42 year old farmer was to a splash of dilute phosphorothioate. About 2 weeks later he slipped while filling the sprayer tank and spilled about a gallon of the 65.7% concentrate on his thighs and legs. It was another two weeks before illness was noticed. Cholinesterase levels were near normal but p,p'-DDE levels in the blood were 111 p.p.b. Other pesticide exposure included atrazine, 2,4-D, aldrin, and heptachlor, all of which gave him a headache while he was using them.                                                          | Same as above.                                                                                                          |
| P-5     | A faulty loading pump sprayed a mixture of ethyl and methyl parathion on a 19 year old aircraft loader. He failed to decontaminate himself for at least 30 minutes because of "the urgency of the loading schedule." He did not become sick until the next day. Upon hospitalization it was found that his cholinesterase level was extremely low. The patient responded to treatment.                                                                                                                                                                                         | Use of personal protective equipment. Training to stress the importance of prompt decontamination.                      |

**Source\*****Account of the Accident\*\*****Countermeasure Suggested**

P-6

On the second day of work unloading a carload of Dasinit, a 29 year old warehouseman became ill. He thought he had gotten too hot. Investigation revealed that the spillage from 5 broken bags had been swept up with a broom creating considerable dust. The patient also noticed granules sticking in an open wound on the palm of his hand. Light clothing was being worn because of the heat.

Use of personal protective equipment, especially when dealing with spills. Containers designed for greater durability in handling.

P-7

While opening sacks of parathion wettable powder, a 29 year old worker felt granules being flipped into his mouth. Became ill.

Simple face mask could have prevented accident. Training needed to stress protection and caution in handling chemicals.

S

A full-time applicator operator had damage occur to his machine causing a hose under pressure to rupture. An unspecified chemical sprayed into his eyes requiring treatment. He was wearing full protective gear except goggles.

Use of full protective gear, especially over eyes.

**Discussion**

The accident accounts above represent a selection from many more reports surveyed. Most of these offer no information useful in determining what countermeasures could have prevented the accident or its undesirable effects on people. When at least one-hundred accidents can be reported in substantial detail from a fairly representative sample, factors can be identified for countermeasure development that can be relied upon to reduce accidents. To our knowledge such information has not been brought to bear on the pesticide accident situation.

This lack of statistically valid information should not keep concerned individuals and groups from applying logic and common sense to the working environment of persons engaged in formulating and applying pesticides. Protective clothing and safety equipment are obviously preventing many injuries or the record of pesticide related poisonings among workers would be much higher.

In our concern for the worker, we should not lose sight of other persons who need protection from the hazards of pesticide exposure. The field re-entry problem is being studied by other groups, but requires more research. Storage of pesticides and other harmful chemicals around the home requires greater educational effort to prevent the terrible toll of child poisonings.

A positive, enlightened attitude about chemical safety among all persons who work with pesticides should be helpful in improving public caution with these substances. Pesticides can improve our total living environment safely if handled with the respect they deserve.

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## THE ACCEPTANCE OF SAFETY PROGRAMS

by

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Safety planners and administrators perennially have been plagued by two questions: how to get people to behave in a safe manner? Why do some people accept safety programs while others resist? Unfortunately, I do not have any pat answers to either of these questions.

In an abstract sense, one might answer the first question — how to get people to “be safe” by discussing the use of a reward system to shape or modify behavior. For example, if we want someone to blink when he hears a bell, we may, by exercising the laws of classical conditioning, shortly induce our subject to blink whenever he hears the bell. As you can see, in order to shape behavior by conditioning we have to conform to a set of prescribed rules and procedures in a controlled setting. It is possible to train the individual to blink at the sound of a bell in an uncontrolled, or real world setting, but the process would be much too time consuming and costly to implement on a large scale. In terms of implementing a safety program, you can readily see that such a technique would not be feasible.

It is also true that we do not have pat answers to the second question — why some people resist change. However, it is known, both intuitively and empirically, that people do differ in their response to program attempts. Some readily accept and try innovations while still others lag behind and “wait and see.” Such observations have led researchers to identify a set of factors that differentiate the “innovator” from the laggard.

Such factors may be personal — such as attitudes toward change, age, education, income — or community related — group norms, peer pressure, concentration of power, to name but a few.

The observation that certain individuals do differ with regard to acceptance of new and innovative programs has led researchers along four avenues of inquiry. The first has been a quest to identify the psychological factors associated with the individual's acceptance or rejection of programming. The second has looked at the community in which the innovator resides, and has attempted to identify community factors associated with innovation acceptance. The third has looked at organizations and identified variables which distinguish between innovative organizations and non-innovative organizations. More recently, research has looked at the program itself and identified certain program factors associated with its acceptance. In this paper I will attempt to review and highlight some of the findings from the study of the individual as an acceptor of new programs and discuss how such findings can be used by administrators charged with implementing new programs.

The earliest work looking at the individual as an acceptor was done by Ryan and Gross (1943), who studied the acceptance of hybrid seed corn by Iowa farmers. Since the Ryan and Gross study, a number of investigations have focused on the psychological characteristics of innovators (for examples mental ability, cosmopolite orientation, self perceptions), sociological attributes (group norms, social status, and communication networks); demographic variables (age, education and financial position) and functional relationships (the degree of specialization and perceived opinion leadership). In 1962, Havens summarized most of these findings in his review of the literature. A summary of Haven's findings are presented in slide 1. Although most of the early studies were in the area of rural sociology, other disciplines such as medical sociology, anthropology, early sociology, education, industry, and recently geography have made significant contributions to our knowledge of the individual as an acceptor of innovation.

Rogers (1962), in his now classic *Diffusion of Innovation*, meaningfully integrated and coordinated the findings in these areas. In his review, Rogers examined results of more than 500 studies. In addition to the review of literature and 32 generalizations regarding innovativeness, Rogers' work offers two additional conclusions of particular importance to administrators and program planners. The first states that the process by which people accept new ideas is not a unit act, but rather a series of complex unit acts. This mental process consists of at least five stages, and these stages can be distinguished from each other in points of time. The five stages as shown in slide 2 are: awareness, interest, evaluation, trial, and acceptance. At the awareness stage, the individual becomes aware of the proposed innovation. He knows about it, but doesn't have the details concerning it. He may know what it is called, but not how it will work. This leads into the second stage, namely, that of interest. Here the individual wants more information about the program. He wants to know what it is, how it will work, and what results are expected. He may also want to

know how the program will affect him or his community. It is in this stage that program planners often lose the interest of their respective target groups. For example, in this stage as was said before, the individual seeks information about the program and develops expectations as to the outcome of the program. If the program planner promises more than the program can actually deliver, these expectations cannot be fulfilled and the individual will not move on to the next step. At the evaluation stage, the individual begins to make a mental trial of the program. He applies knowledge from the previous stages, and begins to ask questions as to what the effects of the program will be on himself, his family and his associates. In other words, he weighs the plus and minus factors. If he decides that the program will work, has value and appears to be the thing to do, he will test it — most likely on a small scale at first. He will discuss it with colleagues or others who have tried it. He sees that it has worked elsewhere, and learns that the idea or concept of the program works. As we said in discussing the interest stage, if the program planner and propagandist have falsely built up the expectations of the individual in the interest stage, then in the test stage, trial run results will not measure up as anticipated, and as a result the individual will reject, rather than accept the innovation. As one can expect, the final stage is that of acceptance. In this stage, the individual accepts the program; he is satisfied with it and will support it.

Knowing the stages an individual goes through in the process of accepting an innovation is useful to the program planner in many ways; it gives the planner information he needs to gauge the communication efforts and tactics used to sell the program. For example, as presented in slide 3, in the first two stages — awareness and interest — mass communication is highly effective, because the individual is seeking information. On the other hand, he is seeking information about the product — he is made aware that the product or program exists — and on the other hand, he is seeking information as to how it works — either explicit or implicit, as to why he should accept the program. The evaluation and test stages are stages at which more personal and interpersonal relations, i.e., two-way communication, seems to be most effective. In these stages, the individual has most of the information that he seeks, he seeks out others who have tried the program, he asks serious questions about how the program will work, how it will affect him personally and what will be his personal costs if he enters into the program. As we said, he's evaluating, not so much the effectiveness of the programs or innovation, but the pluses and minuses of personally entering or accepting the program.

The rate by which the individual moves through these five stages varies; it varies for each individual, it varies according to the organizational community setting in which the individual finds himself, and it varies according to the program. For certain target groups, the process for a given program and time may be shortened by its previous experience. For example, consider the farmer's use of a newly designed and improved respirator when working with pesticides. If the target population is already aware of previous respirators, it may be beyond the awareness stage, or perhaps even the interest stage, having used or rejected previous respirators, previous types of masks, or other personal protective equipment. The population as a whole may be seeking information to evaluate the respirator: how this new technique is different from the techniques and equipment previously used. The program planner can design the material for use by various targets and community groups to help them through the staging process. Publicity through mass communication can be purposefully made to start target groups through this process. As we said, mass communication can be geared and tailored to fit each stage. Two-way communication — questions and answer periods — could be used in the later stages. Perhaps it would require visitations to the intended target group to initiate personal interface discussions.

The second generalization from Rogers' review of earlier works is that the characteristics of innovativeness is normally distributed within the population as depicted in slide 4. Individuals within a population may be characterized as innovators, early adopters, early majority, late majority, or laggards. For example, it can be safely assumed that within a given population approximately 2.5 percent should be innovators, another 13.5 percent early acceptors. Therefore, if we know the length of time that we have been attempting to implement our innovation and if we know the percent of users, we could compare this to the theoretical curve and determine how our program is going. If after, say 3, 4, or 5 years of hard sell attempts to implement our program, we find that approximately three percent of the target group has accepted our program, we can reasonably say that the program is not succeeding, that other avenues must be taken — either scrap or abort the attempts at program change or change our communication techniques, perhaps from mass communications to a more interpersonal approach. Whatever the case may be, we can then use the time cumulative percentages of acceptance as a gauge on how well our attempts to implement the program are succeeding.

Although these past descriptive studies are useful in learning what differentiates early acceptors from laggards and in assessing the success our attempts at program implementation and change are having, it would be most useful to an administrator or program planner if he could have information with which he could predict the acceptability of his attempts at change.

SLIDE 1

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SUMMARY OF LITERATURE REVIEW BY HAVENS  
ON INNOVATION RESEARCH\*

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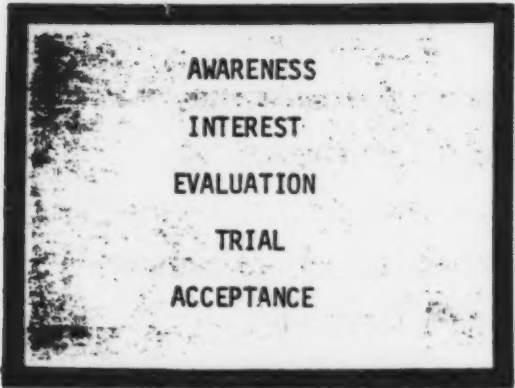
| FACTOR                               | NO. OF STUDIES |
|--------------------------------------|----------------|
| SIZE OF OPERATION                    | 30             |
| EDUCATION                            | 25             |
| SOCIAL STATUS                        | 21             |
| AGE                                  | 8              |
| CONTACT WITH INFORMATION             | 18             |
| SOCIAL PARTICIPATION                 | 13             |
| LOCAL GROUP IDENTIFICATION           | 9              |
| NEIGHBORHOOD NORM ON ADOPTION        | 5              |
| OPINION LEADERSHIP                   | 5              |
| MANAGEMENT PRACTICES                 | 4              |
| SELF-PERCEPTION AND INNOVATIVENESS   | 3              |
| ATTITUDE TOWARD CREDIT               | 3              |
| INTERACTION WITH OTHER ADAPTORS      | 3              |
| READING FARM BULLETINS AND MAGAZINES | 4              |
| *from Havens (1962)                  |                |

**SLIDE 2**

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**STAGES IN THE PROCESS OF ACCEPTANCE**

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**AWARENESS**  
**INTEREST**  
**EVALUATION**  
**TRIAL**  
**ACCEPTANCE**



**SLIDE 3**

**ADOPTION STAGES IN RELATION TO COMMUNICATION MODES**

| ADOPTION STAGES | COMMUNICATION MODE |
|-----------------|--------------------|
| AWARENESS       | MASS               |
| INTEREST        | MASS               |
| EVALUATION      | MASS --- PERSONAL  |
| TRIAL           | PERSONAL           |
| ACCEPTANCE      | PERSONAL           |

SLIDE 4

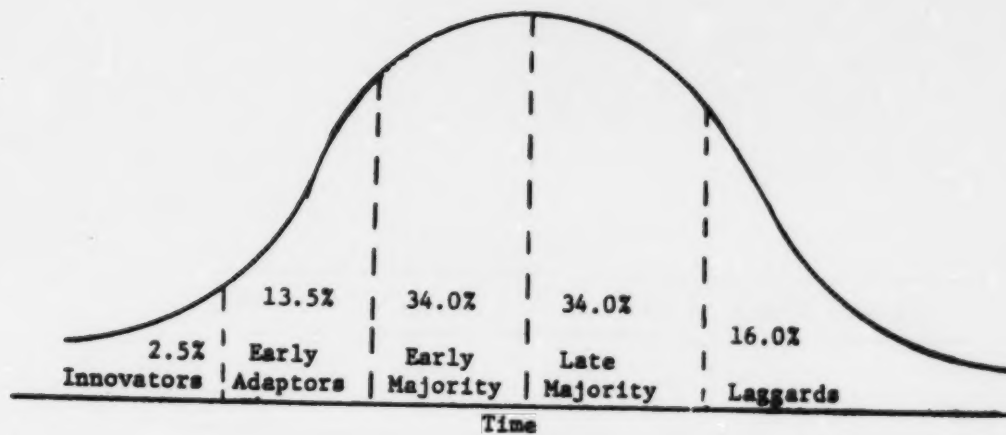


Figure 1. Adopter Categorization on the Basis  
of Relative Time of Adoption  
(From: Rogers, 1962)

Such information would be beneficial in outlining where he should start his program and in what areas he is most likely to obtain success. In other words, where can he get the most acceptance with the least amount of effort? Rogers and Havens in 1962 stated that "Five types of variables are most prevalent in prediction studies. They are: individual attitudes, nature of business operation, social structure, group relationships of the respondents, and communication behavior."

In one predictive study Copp (1956) explained fifty percent of the variance associated with innovativeness by the independent variables of: gross farm income, professionalism, and mental ability. Fliegel (1956) tested the hypothesis that there are no significant relationships between adoption of new farm practices and any one of the six variables: size of operation, authority in farm matters, familism, contacts for information, level of living, and attitudes toward farm practice. All but size and authority were found to be related to adoption. Rogers' (1958) conceptual analysis of variables associated with technological change found change orientation, communication competence and status achievement to be related to adoption. But cohesion with locality group, family integration, and cohesion with kinship group were not.

In a later predictive study, Armstrong (1959) found the multiple correlation of .65 between innovative acceptance and economic position degree of urbanization, and farm specialization. Hobbs (1960) could account for 29.7 percent of the variance by using as independent variables attitudes toward commercial change agents, cosmopolitism, brand awareness, knowledge about innovation, management versus traditional work orientation, gross farm income, and farm size.

Two studies in 1960 found that innovative acceptance could be predicted from knowledge about innovation, social status, education, and social participation (Sizer and Porter, 1960), net worth, education, and wife role supportiveness (Straus, 1960). In a study predicting innovativeness among truck farmers, Rogers and Havens (1961) found that gross farm income, age, belief in agricultural magic, venturesomeness and social status predicted innovativeness. In another predictive study, Rogers and Havens (1962) used five independent variables in a multiple correlation analysis. These variables were community norms on innovativeness, size of farm operation, self-designated opinion leadership, directness of communication behavior with scientists, and social status. These five independent variables were found to relate to innovativeness. "The results indicated that 64.1 percent of the variation in innovativeness, the dependent variable, was explained by the combined effects of the five dependent variables." (Rogers and Havens, page 38)

In a non-rural study to predict future market of a consumer commodity, air travel, Cohen (1962) found that future market could be adequately and accurately predicted from mobility, individual values, and family income.

In an attempt to develop a predictive model of adoption, Finley (1968) studied the relationship of eight factors to early adoption. These eight factors were: age of farm operator, education, size of operation including acres farmed, productive man work units (PMWU) and gross farm income, social status, contact with information, formal participation, and self perception of adoption behavior. Finley found that of these, high social class and productive man work units reached the predetermined criterion of .850 accuracy.

#### **Limitations of Individual as Unit of Analysis**

Most of the findings from previous studies of individual innovation acceptance are of limited predictive use to the administrator of national safety programs. Such studies have usually made use of intensive probing via questionnaire or direct interview. Such a technique is useful in exploratory or descriptive research. However, if the administrator is to predict acceptance so that he can more accurately and efficiently implement a program, any technique that uses extensive, detailed, and costly interviewing is not helpful from a cost standpoint.

Another problem limiting the use of such findings is the fact that the safety program administrator functioning on the national level, and even sometimes on a local level, is usually implementing the program through an intermediary source or agent. A two-step process is involved: organizational implementation first, individual implementation second. Such intermediaries may be governmental agencies, voluntary safety associations or councils, civic groups, etc.

The studies reviewed by Rogers (1962), and which contribute to the knowledge of the individual as the adoptor, have not undertaken such a two-stage approach. Traditionally, the change agent was in direct contact with the target group and the research problems or questions were primarily of the individual as "first" target. An administrator at the regional level does not function on such a one-to-one basis. His task is usually to locate an organization through which he can implement the program. Therefore, the task of such an administrator is identification of innovative organizations or other social systems.

A third, but perhaps minor, limitation is the fact that the research on innovation acceptance has used a non-safety innovation. There have been no studies reported using the individual as the unit of analysis and a safety program as the dependent variable. The assumption has been that there is a degree of generalization from innovation to innovation. However, with regard to safety innovation and individual acceptance this is still an assumption.

In an attempt to overcome these limitations, Vilardo (1971) identified seven community and organizational variables that were associated (Multiple  $R = .50$ ,  $p < .05$ ) with early effective implementation of a safety program. These seven as shown in slide 5 are:

1. Median family income
2. Unemployment
3. Percent of growth
4. Ratio of managers, proprietors, officials to total employees
5. Presence of Organization Handbook
6. Date By-Laws Change
7. Number of board meetings

To the extent that these preliminary findings can be generalized to other programs and situations, these seven variables could provide a base from which an index of safety predictability could be developed.

# SLIDE 5

## ORGANIZATIONAL AND COMMUNITY FACTORS ASSOCIATED WITH THE ACCEPTANCE OF SAFETY PROGRAMS

| FACTORS                           | SIMPLE<br>$r$ | MULTIPLE<br>$R$ |
|-----------------------------------|---------------|-----------------|
| MEDIAN FAMILY INCOME              | -.318         | .318            |
| UNEMPLOYMENT                      | -.214         | .381            |
| GROWTH                            | .222          | .411            |
| M.P.O. INDEX                      | .043          | .423            |
| EXECUTIVE COMMITTEE HANDBOOK      | -.224         | .476            |
| BY-LAWS CHANGED                   | .236          | .488            |
| NUMBER OF BOARD MEETINGS PER YEAR | -.015         | .498            |
| $R = .498$                        |               |                 |
| $R^2 = .248$                      |               |                 |

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## THE CONCERN OF THE FEDERAL GOVERNMENT FOR THE SAFETY AND PROTECTION OF WORKERS EXPOSED TO POTENTIALLY HAZARDOUS SITUATIONS

by

George L. Wyatt  
OSHA-Atlanta Regional Office

At the onset, let me convey to you the regrets of Dr. M. Chain Robbins, Deputy Assistant Secretary of Labor, OSHA. He had planned to be with you at this time, but was unable to do so because of a conflict in his schedule. Both Dr. Robbins and Mr. George C. Guenther, Assistant Secretary of Labor, send their greetings.

I believe we get so wrapped up in our own program at times that we overlook the rest of the world. Everyone has problems. To illustrate, I read the TIME MAGAZINE follow-up to President Nixon's journey for peace. This article told about a nurse among the lathes in a Shanghai machine tool plant inquiring about complaints. Of much more significance to me as a federal compliance officer was a WASHINGTON POST story of April 1, 1972. This story gave an account of an accident in a Minsk radio factory which killed and injured several people. The story goes on to say that the Soviet government has administratively punished a cabinet member and five other high ranking officials, and that these men might be brought to trial as criminals because of the accident.

The Occupational Safety and Health Administration (OSHA) started as a baby a little over one year ago, and we are just now learning to walk. Since our beginning, much water has gone over the dam, and today I would like to review:

1. What the Nixon Administration has done to implement the Williams-Steiger Act?
2. The reactions to the program to date.
3. What we see ahead for you as employers and employees, and for the industry you represent.

On January 20, in his State of the Union Message to Congress, President Nixon reaffirmed his commitment to "a better quality of life for all Americans." He said, "One of the significant joint accomplishments of the Congress and this Administration has been a vigorous new program to protect against job-related accidents and illnesses. Our occupational safety and health program will be further strengthened in the year ahead."

In the first three years of his Administration, the President has addressed himself to environmental quality on many occasions—that commitment continues. What has DOL and OSHA done to date? Organizationally—we are growing rapidly.

1. From the nucleus in December 1970 of LSB with seven regional offices and a number of district offices, we are today an organization with 10 regional offices, 49 area offices and 2 maritime district offices.
2. LSB staff in December 1970 was 300. As of March, OSHA staff is close to 1000, an increase of almost 700 people.
3. As a new organization, we have had the opportunity to implement President Nixon's "New Federalism" policy to the fullest. The President is committed to making government work best by providing services as close as possible to the people served. OSHA is, therefore, a decentralized organization. Our 10 Regional Administrators have broad responsibility and authority, and to date are exercising it well. Within broad national guidelines, they make decisions, and the national office backs them up.

Our first mission under Section 6(a) of the Act is the promulgation of standards. We produced the "initial standards package" one month after the effective date of the Act, on May 29, 1971. These initial standards included construction, maritime, and general industry standards. Their sources were from national consensus standards and from established federal standards already in existence. Contrary to the statements of some, we did not arbitrarily make them up. After a 90 day familiarization period, the standards became generally effective on August 27, 1971. This initial package is only the beginning. We are now in the process of developing new standards such as those for tunnels, and in up-dating some of those already on the book, such as noise and others. Also, in his message to congress on the environment in February of this year, President Nixon placed a great emphasis on the use of

pesticides, and charged the Department of Labor, working with the Department of Health, Education, and Welfare, to develop and implement standards which would assure safe conditions for the use of pesticides. In this connection OSHA is in the process of appointing an ad hoc committee which will address itself, among other things, to the need for standards dealing with the safe use of pesticides.

Our second major mission is to provide a mechanism to enforce these standards. The organization is in place—our compliance officers have been trained and will be given refresher and up-dated training as needed. Our compliance regulations were published in September 1971. Our Compliance Manual is now public and is available through the U.S. Government Printing Office at a price of \$2.00. I understand that during the first six weeks after its release GPO sold 25,000 copies, and had a backlog of 7,500 copies as of March 31, 1971. It appears we have a "best seller."

There are many controversial issues connected with our enforcement activities, but our objective is to concentrate on safety and health issues. We avoid such things as collective bargaining issues, labor-management disputes, etc. Another frequently asked question is "Why aren't employees citable?" My only answer is that the Congress chose to pass the Act as it is written, and OSHA must enforce it in that same manner. There is no provision to cite employees.

When we started our enforcement activities, the Secretary of Labor decided that we should begin on a "worst first" basis. Consequently, the five industries with the highest accident frequency rate were chosen. This program was called the Target Industry Program, and included the following:

1. Longshoring
2. Meat and Meat Products
3. Lumber and Wood Products
4. Miscellaneous Transportation Manufacturing
5. Roofing and Sheet Metal

A little later, it was noted that a large percentage of employee complaints dealt with health matters as opposed to strictly safety problems. With this in mind, it was determined that a new thrust in the area of health was needed. This need was transformed into action, and our Target Health Hazards Program was officially initiated in early January of this year. The THHP, a health counterpart of the TIP, named five hazards which would be targeted in initiating the new health thrust. These five substances are:

1. Asbestos
2. Lead
3. Cotton Dust
4. Carbon Monoxide
5. Silica

Our field inspection priorities used in enforcement of the standards are as follows:

1. Catastrophes and Fatalities
2. Employee Complaints
3. Special Programs
  - (a) Target Industries
  - (b) Target Health Hazards
4. General-Random Selection

Our field activities during the first eight months of the current fiscal year have been quite accelerated. There have been in excess of 20,000 inspections in almost 18,000 establishments employing about 4 million workers. These inspections have resulted in 55,000 alleged violations contained in 15,000 citations. Penalties have been proposed in

about 40% of these cases. About 22% of the establishments have been found in compliance. We consider this to be good, considering our initial emphasis on the target industries. As of March 30, 1972, nearly 800, or about 5%, of the citations had been contested.

Another important part of our endeavor involves the State programs. The Act provides a direct invitation to the States to assume full responsibility on a 50-50 fund basis if certain conditions are met. As of this date, 53 jurisdictions have stated their intentions to submit a plan. The Act also provides, during the start-up period, for developmental grants to States for assisting them to analyze and improve their existing standards and programs in order to meet the requirements for a full-fledged operating program. We have approved about \$6 million for such purposes to 49 jurisdictions. The essential criteria for the States is a new and different kind of State program to be *at least as effective* as the new federal program.

Reactions to OSHA to date can be described in one word—*heated!* I'll give you a few examples:

One mid-western congressman, in a letter to the Secretary of Labor, wrote:

"Reports which I have had from my district indicated that your people are operating under this law in a high handed, dictatorial manner which is reminiscent of the days of Mr. Hitler in Germany....If you people cannot eliminate some of the completely silly and asinine regulations which you have decided upon, there should be a mass replacement of personnel in the Department of Labor....You are going to have a mass revolt and mass violations of the regulations which you people have put out unless you back track and the Congress is already incensed at the manner in which you have begun to enforce this Act."

On the other side of the coin, we read in the AFL-CIO Executive Council statement of February 18, 1972:

"We have weighed the President's words against his deeds and found them wanting. The record is one of foot dragging, flabby enforcement and adulteration of the special provisions of the Act setting forth specific rights and protections for employees."

Congressman Daniels of New Jersey expressed his views as follows:

"Now the hopes of this Congress and their constituents have been undermined by the inept and lax administration of important parts of the occupational safety and health law. A spirit of protecting the lives and health of our workers is barely discernible in many of the Department of Labor's actions. As the chairman of the committee charged with oversight of this Act, I feel that *if* the Department does not speedily correct its attitude and actions in this matter, I will exercise full authority to bring about these changes."

As in all things, the true position is somewhere between these two. In introducing amendments to the Act, Senator Curtis of Nebraska said—

"I have been investigating the problems and their causes and have found that, contrary to the belief of some, the problems are *not* basically due to ill-advised administrative actions by the Secretary of Labor in carrying out the law. The problems are rooted in the basic law which Congress passed. It is therefore not a matter which the Secretary of Labor or the President can remedy. Rather, the problems to which I refer are the responsibility of Congress."

The stage, therefore, is set for further consideration of the Act by Congress. At the present time, there are sixty-three bills to amend the Williams-Steiger Act in the hopper.

Now, what do we see ahead. OSHA is continuing its approach to solving the job safety and health problem. One of the problems we have had in developing the OSHA program is a lack of clearly defined statistics. We are hopeful that our new recordkeeping system will provide us with much more meaningful information than we have had in the past. Based on the injury statistics presently compiled by the Bureau of Labor Statistics, it is difficult to attempt to compare your injury frequency rate for pesticides with that of general industry. The figures we have, however, do indicate that your injury frequency rate runs somewhere less than the all manufacturing average rate of 14.8. I would hope that our new recordkeeping system will indicate further reductions in the future.

The present OSHA standards covering the pesticide industry are limited. In publishing the initial standards package we did not include such standards because many states and local programs do exist and pre-emption by federal standards was not practical at that time. Also, further study of the jurisdiction of the Environmental Protection Agency and the Department of Agriculture was necessary.

We do believe, however, that certain national consensus standards should be adopted under OSHA. We propose to study this problem with view to adopting such standards in the future. We are now engaged in talk with the Agriculture Department and EPA regarding jurisdictional questions and anticipate clarification in the near future. Certain of our existing standards are now applicable to your industry. I refer specifically to 1910.93 on Air Contaminates and to 1910.134 on Personal Protective Equipment. The latter is a particular interest to this group considering the stated subject of this meeting.

We are, therefore, proceeding cautiously but at the same time as rapidly as possible to provide further coverage for your industry. Any and all inputs from your industry with regard to appropriate standards will be appreciated and carefully considered.

From the beginning, we have constantly stressed the vital importance of "voluntary compliance" if this worthwhile program is to succeed. We in OSHA will continue to stress voluntary compliance. Employers and employees across the country are in fact already engaged in broad new job protection programs. At a recent White House Conference on the Industrial World Ahead Through 1990, Dr. M. Chain Robbins, Deputy Assistant Secretary of Labor, OSHA, stated that by that year he believes we can look back on the 1972 toll of occupational injuries and illnesses as a thing of the past, in the same sense that we today can look back on polio and tuberculosis. We conquered those—together we can eradicate occupational hazards.



**CONFERENCE PANEL DISCUSSIONS  
AND RECOMMENDATIONS**



## **PANEL NO. 1: MANUFACTURING AND FORMULATING PLANTS**

### **Segment No. 1**

#### **Protective Gear:**

1. In general, the protective gear recommended for use by workers in most plants should include protective shoes, clean coveralls (daily), gloves, face shields, cloth caps, underwear and socks.
2. Footgear is very important – need boots 6–8" high with hard toe, outer surface resistant to wide variety of chemicals. Most available footgear falls apart too readily. Permanent footgear is costly in plants with short-term employees.
3. Hard hats have sweatbands which act as accumulators of chemicals. Their use in chemical plants should be discouraged in many instances.
4. Certain face masks may impair worker efficiency if worn more than 4-5 hours a day. In some instances air-supplied helmets may be necessary.
5. Respirators may not be as useful in plants as they should be because: a. There may be a need for interchangeable cartridges to deal with different kinds of chemicals; b. There should be a better signaling device to tell when to change cartridges (some indicate for wrong kind of chemical, such as carbon monoxide); and c. There should be canisters which indicate a shelflife record.
6. Dust filters are an important need when working with wettable powders and dusts.

#### **Management and Operation:**

1. Smaller chemical plants have greater problems in providing protective clothing and safety equipment due to their flexibility of operation in changing from one product to another.
2. Smaller plants may not be able to design or redesign plants to provide worker protection from chemicals to the extent that Chemagro demonstrated.
3. Should testing systems (for example, air sampling devices) be installed throughout the operating areas of plants to determine safe levels of chemicals?
4. Should cholinesterase testing programs be instituted in all plants dealing with chemicals? Baseline levels would be needed for new employees. Need to select example-setter, such as plant manager, to lead others to get blood tests, etc.
5. Showers and laundry should be on the premises. A complete change of clothing after showers is recommended. A daily shower immediately after work should be mandatory.
6. Do certain containers for chemicals pose a greater hazard than others for workers? Is there emphasis on greater need for protective gear when using these?

#### **Information Provided and Needed:**

1. Managers often know kinds of safety gear needed, but workers often fail to use them.
2. It was suggested that an organization such as NACA gather and disseminate information on safety equipment and protective clothing.
3. Safety and handling information from basic manufacturers to formulators about their products is made available and is good. A question was brought up about the desirability of formulators providing similar information to users.
4. If basic manufacturers were to recommend safety equipment, etc., to formulators, they would need to know kinds of equipment and conditions in the formulating plants.
5. Doctors' reports in relation to the responsibility of managers to workers was discussed. There are problems of getting meaningful, accurate reports of illnesses.
6. More research is needed on barrier creams for application to skin to determine if they are practical and effective to protect workers.

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## **PANEL NO. 1 – SEGMENT NO. 2**

### **Identification of Problems:**

1. Problem with handling of raw material rather than pesticides.
2. Attitude towards respirators – this negative attitude is worse among older employees.
3. Nuisance – employees claim respirators are irritating.
4. Cost effectiveness of dilution ventilation.
5. Controls and safety are worse among subcontractors.

### **Recommendations or Suggestions:**

1. Prepare for distribution a movie of someone who has been poisoned.  
The above movie could be part of a training program.
2. Give people a choice of safety equipment. The psychological effect of having a choice will be felt rather than a bold order to use a single piece of equipment. This can be done with catalogs and brochures.  
Then teach the employees how the equipment works.
3. Plant manager or equivalent is the level at which enforcement of respirator program must start. Let him insure the success of the program. An industrial hygiene group simply cannot get around enough to check all the time.

Some gimmicks to assist are:

- a. "Wise Owl" Club of National Society for Prevention of Blindness
  - b. Turtle Club (for hardhats)
  - c. Golden Toe Club
4. Do not make people wear safety equipment where it is not needed. Solving work environmental problems is first priority.
  5. Something is needed to insure uniformity of safety equipment and codes. Interchangeable canisters for gas masks and respirators are an example.
  6. A kit containing antidotes and other drugs pertinent to the chemicals being handled as well as medical bulletins written in clear language to accompany patient when being taken to a doctor, emergency clinic, or hospital emergency room. Such a kit with its vital information could prove life saving. This kit is for the use of a physician and is not intended for administration by laymen.
  7. The manufacturer should have its own laundry for coveralls and work clothing or else work out with the coverall vendor a policy which will keep the company's coveralls separate from the rest of the vendor's load.
  8. As an alternative to "7," good disposable clothing is available which would be preferable to laundering when it can be used.

### **Needed Research:**

1. There is a need for clothing that is comfortable yet will shed a liquid spill. (Cotton absorbs a spill.) The clothing should be warm enough that the employees do not wear their own garments underneath.
2. Safety shoes are needed which will be light, cool, comfortable, yet are protective. Perhaps they should be leather inside, synthetic out. Liquid spills on shoes are a common hazard, the shoe then becoming a source of future poisoning.

### **Government Can Do the Following:**

1. Approve parts of one manufacturer being used on another mask; i.e., a Wilson cartridge on a MSA mask to permit interchange of cartridges, standardization of connections, or provide adaptors for interchange of cartridges.
2. Encourage small formulators to develop programs similar to large ones. This could be done through county agents.
3. Even-handed enforcement by government.
4. Encourage safety information exchange.

**See attachments**

**Attachment 1**

1. The report stresses the negative aspects of personal protective equipment.
2. We feel that the psychological effects of wearing personal protective equipment even if the hazard is slight, increases general safety awareness.
3. Certain minimum personal protective equipment is basic to nearly every process. As an example, our company is developing product data sheets which include personal protective equipment to be worn by workers who are involved with these products.
4. Specific kinds of personal protective equipment pertaining to each product is printed on the bottom of these product data sheets.
5. If the type of operation is apt to result in an environment that requires personal protective equipment at any time, then it should be readily available for that occasion. Therefore, the personal protective equipment should be worn or attached to the person who will need it.
6. We felt that emphasis should be placed on the need for manufacturers to standardize the kinds of equipment (particularly respirators), so that they might have interchangeable parts.

**JOHN R. SIGLER**  
Safety Director

## PANEL NO. 2: LOADING AND TRANSPORTATION SITUATIONS

Assessment of needs and formulation of recommendations for research, regulations, improved information dispersal and alternative practices – panel subject assignments have been limited to specific areas where pesticides and people are in close proximity and where safety clothing and protective equipment may need to be available or in use.

### Discussion:

Regulations for: 1. Marking, labeling, handling of hazardous materials

2. Storage

3. Shipping

4. Decontamination

5. Waste Disposal

are found in the Code of Federal Regulations, Title 49 – Transportation, Parts 100-199. Published by the Office of the Federal Register, National Archives and Records Service, General Services Administration, U.S. Department of Transportation and the Bureau of Motor Carrier Safety.

Motor Carrier Safety Regulations specify driver's responsibilities in providing protection of goods being carried.

Section 177, CFR, Title 49, covers regulations of transportation by highway by private contract carrier and spells out duties of the carrier to instruct its employees concerning protection procedures.

One of the purposes of this panel discussion is to define the problem of transportation of pesticide products.

Carriers are in need of improved training in the field of chemical handling programs.

In terminal situations the clean-up (decontamination) crew employed by the carrier needs recommendations as to safety devices (location and use thereof).

Trucking industry is mainly carried out in two phases: 1. Pick-up and delivery; 2. Line haul drivers.

Leaks occurring in pesticide containers during transportation results from pick-up drivers and line drivers often changing during a long-distance haul. Drivers are not experienced or educated in hauling the pesticide. They may only haul pesticide occasionally and thus are not in a position to require extensive training in the subject. Pick-up and delivery type operation gives the most problem.

Containers for transportation of hazardous materials must be manufactured by federal regulations, persons should notify the U.S. Department of Transportation, Bureau of Motor Carrier Safety, Federal Highway Administration, Washington, D.C. Only by public input of information such as this can the regulations be enforced, changed or improved. Title 49 of DOT gives guidelines for reporting violations, accidents, incidents, etc.

Proposals have been offered to Department of Transportation to:

1. Provide drivers with kits for decontamination

2. At terminals, provide equipment for decontamination

Mr. A – To date, we had no recognized driver-oriented problem with transportation of pesticides.

Mr. B. – We must assess the hazards involved in pesticides, fumigants, containers, etc. For example, highway accidents involve different factors than terminal accidents. Let's discuss the protection of the driver.

Mr. A. – The containers made today are designed for severe highway accidents.

Mr. B. – Are there procedures that the driver should follow in case of leakage?

Mr. A. – 177.860 describes the procedures. Particularly Part A-1 which describes decontamination procedures of carriers and containers, protect the public against contamination, traffic emergency indicators (flares, etc.).

Mr. A. – Under DOT these testing procedures are required annually:

1. Physical exam of drivers

2. Driving exam for drivers

3. State law requirement exam for drivers

Most accidents occur due to negligence or lack of education of terminal workers and drivers. Drivers and terminal workers should receive more frequent and extensive training in the transport of poisons.

Mr. C. – Clothing should not be carried with Class B poisons. Recommend that DOT should prohibit carriage of these two items together.

Mr. A. – In the United States there have not been any large spills of Class B poisons in metropolitan areas, causing loss of life.

Mr. D. – One of the problems (in safety business) is the matter of credibility. Automotive industry has "its bristles up." DOT has not done enough in the part to enforce safety in design of equipment and overall transportation system. Safe vehicles will not help if the system has weaknesses such as loading problems, handling and recognition of hazardous materials. Let's build a better overall system. Better labeling might help.

Mr. A. – The answer is found in the handout titled "Reports of Hazardous Materials Incidents;" however, this is only a summary of reported incidents. We do not know all the unreported incidents.

Mr. E. – Drum failure reports (containers) showed types of accidents and reasons for container failures.

**PANEL NO. 2: LOADING AND TRANSPORTATION SITUATIONS (Continued)**

- Mr. C. - I feel the containers are now being manufactured in accordance with the Federal Specifications satisfactorily.
- Mr. A. - Described some incidences of container failures due to stress cracking which occurred during shipment of drums over long distance (metal fatigue). Poor quality control of containers at some manufacturer's plant is one reason for some defects which occur.
- Mr. C. - We have better civil enforcement of regulations than in past years, but need more enforcement.
- Mr. D. - Safety engineers need input information from the public concerning reasons of accidents.

**See attachments**



**PANEL NO. 2: SUGGESTIONS SUBMITTED BY W. V. ANDRESON,**

The provision of safety equipment for individual transportation equipment does not appear to be either warranted or practical since literally thousands of trucks and railcars are used in full and LTL shipments. There is usually safety equipment available at the manufacturing plant and to many of the Distribution Centers.

The N.A.C.A., M.C.A. and individual company emergency networks and teams provide excellent service by trained technical personnel in situations where leakage occurs in transportation equipment. The truck driver could not be expected to have technical knowhow and in the interest of his safety it might be better not to have him involved but instructed to seek available help.

There are other complications such as maintenance and cleaning of safety equipment which would be difficult to implement.

**Notes of Discussion Period:**

The Department of Transportation has the responsibility for promulgating and enforcing regulations to protect the public during the interstate and foreign shipment of hazardous materials. The Office of Hazardous Materials is the Department's principal staff element dealing with the transportation of hazardous materials such as: Explosives, Flammables, Radioactive Materials, Corrosives, Compressed Gases, Poisons, Oxidizers, Etiologic Agents and Cryogens.

One of the principal functions of the Office of Hazardous Materials is to develop and to recommend for adoption by the appropriate operating administrations, regulations on classifying, packaging, marking and handling of hazardous materials for their safe transportation.

This agency has regulatory authority in the following areas when the pesticide is classified as a hazardous material in accordance with the Code of Federal Regulations, Title 49 - Transportation, Parts 100-199:

- (1) Pesticide Packaging
- (2) Pesticide Handling
- (3) Pesticide Storage (in Transit)
- (4) Pesticide Shipping
- (5) Pesticide Labeling
- (6) Pesticide Waste Disposal (in Transportation)
- (7) Pesticide Decontamination (in Transportation)

Before specific regulations are instituted requiring protective clothing and equipment for workers involved in transportation of pesticides, we should establish minimum performance standards for such clothing and equipment.

Mr. Willis F. Mitchell  
Office of Hazardous Materials

### **Attachment 3**

The need for work and education to help professional applicators, including farmers, select and use protective clothing and safety equipment is great. It appears that the research and development of this equipment has not kept pace with the introduction and registration of new chemicals.

These are some statements to ponder:

1. Most users of parathion (even on highboy sprayers) do not use respirators, rubber gloves, etc.
2. P.C.O.'s applying Dursban and Baygon in kitchens and bathrooms use little to no protective equipment or clothing.
3. Most of the professional applicators using the highly toxic organophosphate insecticides are not under a blood testing program. We would like to have a list of laboratories (certified or authorized) where blood testing for cholinesterase is done.

Ray P. Kriner, Coordinator  
Pesticide-Chemicals Program  
Extension Service, Rutgers

**Attachment 4**

**Factors considered in transportation of hazardous materials by air carriers. (Proper labeling will cover these factors)**

1. Shock  
Vibrations  
Are slings required?
2. Pressure — up to equiv. of 8,000 ft. M.S.L.
3. Ambient temp.  
Dry ice (refrig.) needed?  
Heating?
4. Can passengers be allowed in same space?
5. Containerization?  
Spillage dams?
6. Movement restriction  
Wt. & balance limits of aircraft  
Netting  
Tie downs  
Non-slip knots  
Straps
7. Time factor  
In loading  
En route  
Unloading  
Temporary environment control needed?
8. Loading  
Pro's & con's  
Pilots should supervise because of weight and balance problem, but pilots should not load
9. Testing & examinations of pilots inspections of planes.
10. Suggest a general review by cross-checking DOT, FAA regulations concerning air carrier regulations concerning carrying of Class B poisons.
  - (1) What type poisons are prohibited to be carried by air?
  - (2) Pilots protective clothing required?
  - (3) Requirement to isolate from passenger compartments.

Suggest review of FRA's (Fed. Aviation Regs.) Part Nos. 43, 61, 65, 91, 97, 103, 121, 127 & 135.

The point was brought up that the questions will be discussed at the Seminar on "Air Transportation of Hazardous Materials" by DOT on May 18, 1972, at Berkeley, Missouri.

Frank Lerchen  
Maritime Administration, DOC

That DOT accident data be analyzed to determine all applicable safety measures in:

- a. Identification of Hazardous Compounds
- b. Loading Hazardous Compounds
- c. Accident Emergency Training
- d. Leaker Handling Training
- e. Safe Cleanup Training

That loaders and drivers be given appropriate retraining, based on accident investigation in handling, loading, leakage and accident measures.

**Summary:**

Identify specific accident factors from DOT accident records. Feed back effective counter-measures to all involved sections

Handling  
Loading

Accident Procedures  
Leaking Procedures

DOT requires protective equipment where protective equipment is found to be a necessity to prevent a pesticide injury.



### PANEL NO. 3: STORAGE AND WAREHOUSING ENVIRONMENTS AND DEALERS AND DISTRIBUTION OUTLETS

Most of the safety problems that were discussed were related to warehouse location, design and/or construction. The following points were stressed:

1. Warehouses for agricultural pesticides are frequently located in relatively remote places where communications, fire protection, police protection and water availability may be poor.
2. Warehousing operations may be carried out in buildings not designed for the purpose or in multipurpose structures. For example, farmer-dealers may store products in pole barns; organophosphates have been known to be stored on upper stories of business buildings.
3. Warehouses are sometimes located near residential or in downtown areas or close to food storage or processing facilities. In many cases closely associated with nurseries, feed mills, hardware stores, and farm implement and supply stores.
4. Building construction is variable and frequently adds to the problems of safety:
  - a. Office and shop or processing areas are often a part of the warehouse.
  - b. Floors are sometimes wooden.
  - c. Floors above ground level increase the hazards of forklift truck operation, but may be necessary where flooding is a problem or delivery is by railroad.
  - d. Ventilation is often inadequate.
  - e. Washing facilities are often absent.
  - f. Although sprinkler protection is a current requirement this is not always feasible and may be added to the safety problems associated with pesticide fires. No provisions have been made in the sprinkler requirements to account for hazardous runoff as a result of sprinkler operation. Cost for sprinkler system installation may exceed cost of warehouse construction.
  - g. Security against unauthorized entry into the pesticide storage areas of the warehouse is not provided or adequate.

In some instances warehouse management seems to contribute to problems of safety:

1. In some cases pesticides are not adequately or properly separated from other products: feeds, hardware, different types of pesticides, fertilizers, etc.
  - a. Wrong juxtaposition may contribute to fire control problems.
  - b. Separation by a wall is not necessarily adequate as was indicated by reference to a forklift truck incident in which the fork penetrated the wall.
  - c. Proper placement of different types of products on different floors is sometimes neglected (as with storage of highly toxic pesticides above feed, etc.).
2. Processing operations such as feed mixing are sometimes allowed in the warehouse.

The major warehouse safety problems appear to fall in four categories.

1. Cleanup, disposal and contamination problems in the wake of disaster, such as tornadoes or fires, are of major concern. Location of the warehouse is an important contributor to problems in such instances.
2. Routine handling of highly toxic dusts, powders or granules in paper packaging may be hazardous due to dusting of the products.
3. Breaks, leaks, and spills seem inevitable, especially during transit to and from the warehouse and during forklift truck operations. These add to the other handling hazards.

PANEL NO. 3 (Continued)

4. The problems posed by these latter two types of hazard are multiplied by an apparent refusal of laborers to routinely wear protective gear.
5. Warehousing of pesticides, fertilizers, and other farm chemicals in the same building complicates the safety factors, the fire hazards, and consequent fire handling facilities.

Many methods of improving warehouse safety were suggested and are listed below. These suggestions are not all directly related to protective equipment and clothing. The intent is to list "all" suggestions made, not just those that were acceptable to the whole panel.

**Suggestions Relative to Warehouse Location:**

1. Should not be located near residential areas or food storage or processing plants.
2. Should be located at or outside the city limits, although location outside the city limits may preclude adequate fire and police protection. Police and fire protection should be available.
3. The prevailing wind should be considered in warehouse location.

**Suggestions Relative to Warehouse Construction:**

1. Office and shop or processing areas should be separate from the warehouse, without common walls or ventilation.
2. Floors should be concrete, whether ground level or not depends on local conditions (potential for flooding) and on operation practices (ground level is preferable for forklift truck operations).
3. If drain is included it should be into a sump although this might lead to contamination of ground water.
4. Diking would be desirable though probably not feasible from the economic standpoint.
5. Alternatives to sprinkler protection should be considered (foam was mentioned). Water control of fires may greatly complicate clean-up operations. Water must be available if fertilizers are also warehoused.
6. Washing facilities with floor operated faucets should be available.
7. Ventilation should be adequate.
8. Electrical switches should be spark-proof.
9. Proper security measures must be provided.

**Suggestions Relative to Warehouse Management:**

1. Warehousemen should be specifically educated concerning the handling and storage of pesticides. This education should include:
  - a. Hazards of routine handling and emergency situations.
  - b. Need and use of safety equipment and clothing.
  - c. Proper segregation of pesticides from other products and operations.
2. Licensing of the warehouse manager may be desirable (and probably will come with new legislation).
3. Warehouses should have protective equipment and supplies available and in good repair (routinely inspected?) for emergency operations. Such kits are currently being supplied by certain manufacturers and should contain such things as full protective clothing (pants, boots, jacket, gloves, goggles, respirators, etc.) absorbents and/or neutralizers, brooms, shovels, etc. Whether antidotes should be included in the kit is open to question.
4. The local fire department should be informed of the location of pesticide stores and the potential hazards involved. And should be informed of pesticide type and location of such storage in the warehouse.

PANEL NC (Continued)

5. One specific local physician should be informed of the pesticides being stored, their problems and antidotes and should have the antidotes on hand.
6. People should be kept out of the warehouse as much as possible. Unauthorized personnel should not be allowed in the warehouse.
7. Where appropriate, warnings should be in multilanguages. Perhaps color coding and/or glyphs should be adopted.
8. Periodic routine inspection should be standard operating procedure to check for and dispose of torn bags, leakers, and improper or hazardous storage.

**Suggestions Relative to Handling Hazards:**

1. Routine handling of pesticides packaged in paper bags where dusting is a problem should be done with gloves and coveralls or aprons, or such pesticides should be packaged to eliminate dusting. Respirators should be available in case of need. Long sleeved shirts should be worn if coveralls are not used to cover arms.
2. Packaging in glass should be eliminated. Care should be exercised in handling all packages and containers to prevent tearing, puncturing, breaking, or bending of containers.
3. While packaging in waterproof containers might prevent some of the problems resulting from fires, problems of container disposal would be increased. Water soluble packaging will add to the problems of pesticide fires.
4. The appropriate type of gloves to use with certain pesticides in certain circumstances seems open to question (should research on this matter be recommended?). Answer—definitely research should be recommended.
5. Formation of local disaster teams, possibly as an arm of official agencies, to deal with hazardous situations.

**Attachment 1**

There are problems related to location, design, and construction of pesticide warehousing which are outlined in the information provided me. There have been some good suggestions related to warehouse safety which were presented by the panel. With regard to warehouse construction, I would like to question Item 8 referring to electrical switches being sparkproof; realizing that in manufacturing, some conditions could exist where sparkproof switches should be used. We have been unable to find any pesticide that would require a flammable label nor can we think of any situation that would cause enough dust or vapors from solvents to be of such concentration that a sparkproof switch should be used.

I would also like to offer a suggestion relative to warehousing management. Most regulations, related to safety, are devised for the protection of the employee. Past history tells us that regardless of the regulations, people are continually being hurt because they do not comply with these existing regulations. Therefore, my suggestion is that the employee be informed when he is hired or when he begins to work in a warehouse, that if he fails to follow safety regulations or fails to utilize safety equipment provided for him, he shall be subject to dismissal, not only for his own good and his family's good, but for the good of both the community and the nation.

A person who is injured and is unable to work at his full capacity to support himself and his family increases the burden of the taxpayers in both the community and the nation.

L. F. Curtis  
Manager, Operating Services



## Attachment 2

I believe that a better definition of the safety problems in the pesticide industry are necessary. Subject to correction, I am of the opinion that safety practices in production plants operated by major producers of agricultural chemicals generally exceed any of the contemplated standards. Certainly standards in many formulating plants, warehousing outlets, and applicators do not conform to the current incomplete standards.

An analysis of the safety needs of the industry should be made. I believe that the accident rates might be ranked as follows:

1. Mechanical, from moving vehicles as tractors, trucks, trailers, forklifts, lifting, and maintenance and repair.
2. Toxic exposure during application.
3. Toxic exposure during formulating or manufacturing.
4. Toxic exposure during warehousing.

In the past 8 years and perhaps longer, our company has not had a lost time accident as a result of #4. We have in the past 5 years had a number of less than 5 day lost time accidents as a result of #2 and #3. We have had 2 fatalities as a result of #1.

The quality of personnel engaged in the warehousing of pesticides in our company is generally superior to that which we would employ in other warehousing operations. This is caused by the need for them to be able to clearly read and understand labels of products they are shipping, to prepare bills of lading and documents to conform to the stringent DOT regulations, and to protect the health and safety of themselves and our customers.

There are a limited number of major production plants for pesticide production, and these are generally of substantial size making safety requirements relatively manageable. There are hundreds of formulating plants in the United States where again reasonable standards of safety can be met. There are, however, thousands of retail and public warehousing sites, many of them handling limited quantities of pesticides, where standards geared to the handling of pesticides in a formulating or production plant and applied to the warehouse would be economically staggering. Further, the accident record of this particular group as regards toxic exposure of pesticides, I would expect to be minor.

The purpose of the above then has been to recommend that an in-depth study be made of the incidence of accidents caused by exposure to toxic materials in warehouse facilities, to define the need for safety precautions, and to produce safety requirements which are reasonable and effective.

The writer would be happy to contribute, at any time during your deliberations based upon his experience with his own organization which has 44 warehouses engaged in the retail distribution of pesticides in a number of states and in widely variant situations as to water availability, fire protection, police protection, and exposure to the public. Thank you very much for the opportunity to participate in the meeting in Atlanta.

E. T. Wadsley  
National Director  
Agricultural Services



## **PANEL NO. 4: FARMER AND FARM WORKER PRACTICE IN APPLICATION AND USE OF PESTICIDE PRODUCTS**

### **Background Situation:**

1. Simple acute oral and dermal toxicological data are insufficient to meaningfully assign classifications for pesticides. More accurate assessment of hazard in addition to LD50 data is needed.
2. Long-term exposure to pesticides by humans has indicated that there are slight variations in biochemical values of different types. Thus, until the impact of these changes upon human health can be accurately evaluated, undue exposure to pesticides should be limited by the use of protective clothing, equipment and work practices.
3. Pesticides should be classified according to hazard presented to the user by virtue of formulation, mode of use, etc.
4. Use of safety and protective equipment should be commensurate with the hazard in the use of chemicals. The information and use of pesticide safety protective equipment should be tied to distribution of chemicals. Pesticide dealers should be tied to distribution of chemicals. Pesticide dealers should also handle pesticide safety equipment.
5. Four kinds of illness attributable to pesticide exposure were recognized as follows:
  - a. Unreported - workers remove themselves from exposure situations
  - b. Recorded - workers see a physician
  - c. Acute - overt exposure
  - d. Cumulative - time related

### **Research Needs:**

1. Where is the hazard? Determine the cause and the degree of problem by statistical sampling for:
  - a. Use hazards - long term
  - b. Accidental involvement
  - c. Effectiveness of barrier creams
  - d. Effectiveness of safety equipment
  - e. Effectiveness of protective clothing
  - f. Safety of pre-calibrated ingredient packaging
2. Evaluate the various kinds and types of safety and protective equipment:
  - a. Suit types and materials including disposable items
  - b. Headgear
  - c. Respirators - improvement, comfort and filtering under thermal stress; indicator to show when cartridge overloaded
  - d. Goggles - need, fit and use
  - e. Gloves - types and use
  - f. Footwear - types and use
3. NIOSH establish limits of pesticide exposure recognizing complexity of problem

**PANEL NO. 4 (Continued)**

**Regulatory Needs:**

1. Standards for containers - i.e., no glass for emulsifiable concentrates (organic phosphates) in stores; include splash-proof pouring spout, etc.
2. Support for proposed federal legislation - licensing and training of operators
3. Thermal stress protection - work times might be established
4. More realistic or practical protective gear statements on label

**Information Needs:**

1. Consolidation of literature on pesticide safety
2. Literature for local media and schools:
  - a. Program materials which stress pesticide safety and pest control alternatives in schools, short courses and science curriculums
  - b. Public affairs, consumer oriented, literature for mass media

**Worker Protection Suggestions:**

1. Stop work or operation if workers get wetted through to skin
2. Protective equipment use:
  - a. Wear wide-brimmed waterproof hat
  - b. Wear lightweight, light color, waterproof jackets
  - c. Wear waterproof boots and shoes
  - d. Wear longsleeved regular coveralls or longsleeved washable cloth jacket if waterproof items unbearable in hot weather
  - e. Wear respirator for highly toxic pesticides
  - f. Wear goggles while mixing pesticides—not usually needed during application of most pesticides
  - g. Wear unlined gauntlet (waterproof) gloves
3. Read and follow safety precautions on labels. Use protective equipment when indicated.
4. Establish cholinesterase base levels for workers - work with local doctors
5. Train workers on pesticide safety and emergency procedures
6. Work in pairs - never singly when handling highly toxic pesticides
7. Wash respirator daily following use

## **PANEL NO. 5: COMMERCIAL APPLICATIONS AND USE OF PESTICIDE PRODUCTS**

The Panel found that current safety practices related to commercial applications of pesticides are limited to the use of the following safety devices:

|             |                                 |
|-------------|---------------------------------|
| Respirators | Boots                           |
| Gloves      | Face Shields                    |
| Aprons      | Chemical (Rain) Suits           |
| Goggles     | Soap and water                  |
| Coveralls   | Protective ointments and creams |

The present equipment was considered adequate for the intended conditions of use.

Information with respect to the equipment is believed adequate and available but neither organized nor disseminated to the pesticide applicator.

- a. The Panel recommended that the Federal Working Group on Pest Management investigate the possibility of establishing through ANSI a standard for personal protective equipment for pesticide application.
- b. The Panel recommended that the Federal Working Group on Pest Management recommend the development of a single source of information or guidelines for the use of personal protective equipment related to the application of specific pesticide uses.
- c. Aside from the very narrow charge concerning protective clothing and safety equipment the Panel felt there is a need for a data bank with retrieval system to categorize, describe and provide answers for all known pesticide problems.

#### Attachment I

In addition to those items listed as safety devices that are currently in use by commercial applicators and pesticides, it might be well to add, "enclosed environmental systems." This would be the cockpit of an aircraft or the cab of a tractor that has been pressurized to draw air in from a single source in the forward area of the equipment that would be relatively uncontaminated by the pesticide being sprayed, and it might also include air conditioning. In addition, we use a "hard hat" type helmet that is a self-contained gas mask in addition to perhaps containing an air conditioner hose and outlets for radio equipment. This could perhaps be summed up as a safety helmet.

Other safety devices that might also be listed would be see-through plastic chemical tanks that could be observed from the cockpit area, so-called "bottom loading" devices so that the material does not have to be lifted into the hopper but is pumped into the aircraft through a quick-coupling device located under the pilot, and quick-release "dump" valves in order to quickly dispense all the material in view of a possible impending disaster or malfunction of equipment. There are possibly several others that I am still leaving out.

With respect to the recommendations of the panel, I agree that the equipment listed may be considered adequate for intended use, however, in most cases the use exceeds the conditions of use. An example of this comes from a look at chemical (rain) suits as listed by the committee. In this case, an applicator in Arizona may die from heat prostration because of the lack of ventilation while wearing the suit. A more serious problem exists when these suits are not fire resistant and many times made of a material such as nylon which will increase the severity of a burn to the maximum possible extent.

In view of the above, I would like to add one very important recommendation to those of the panel, and that is the establishment of a National Testing System or Group that would determine standards of protective devices. No one should be allowed to market a device that is actually more dangerous than what it is trying to protect.

I am sorry that I didn't have more time to consider some of the aspects of this very important subject but you know you can count on me for any further information or work on any committee which is considering safety.

Farrell Higbee  
National Agricultural Aviation Association

The Safety Equipment needs for our particular industry are fairly well listed in the Checklists of Safety Equipment which have been developed by our Operations Committee for General Pest Control, Bird Management and Termite Control.

An analysis of these lists shows that there is more emphasis on equipment to handle and apply the pesticides properly than to protective clothing and masks. There are, of course, two valid reasons for this.

1. Most of our pesticides are of a relatively low order of toxicity.
2. There is *great* workman resistance to the wearing of protective equipment where the hazard is not readily apparent, and it is more productive to train in application techniques than to enforce the use of undesired equipment.

We also get an indication of the safety equipment needs of our industry from our record of injuries to workmen. We get some valid indication of this record from our insurance compensation record. Our staff was granted access to the insurance records of one insurance broker who specializes in providing liability and compensation insurance for our industry. This broker insures 1,200 to 1,300 exterminating firms and we estimate from the distribution of our members according to size that these firms employ from 10,000 to 15,000 service personnel.

We have made studies of the compensation claims processed by this broker over two periods of time, a four-year period 1961-64 and an approximate four year period from late 1967 to late 1971.

We list below the results of a rough categorization of the claims according to the cause of the injury claimed or the type of injury claimed.

**Analysis of Accident Claims for  
Employees of Structural Pest Control Firms\***

| Basis of Claims                      | 1961-64    | 1967-71    |
|--------------------------------------|------------|------------|
| Falls                                | 48 (31.5%) | 96 (22.8%) |
| Strains                              | 31 (20.4%) | 71 (16.9%) |
| Bumps and Bruises                    | 25 (16.4%) | 78 (18.6%) |
| Cuts and Punctures                   | 7 (4.6%)   | 46 (10.9%) |
| Eyes                                 | 2 (1.3%)   | 17 (4.0%)  |
| Vehicles                             | 20 (13.1%) | 44 (10.5%) |
| Chemicals                            | 12 (7.9%)  | 30 (7.1%)  |
| Illness on Job                       | 3 (2.0%)   | 3 (0.7%)   |
| Stings and Bites<br>(including dogs) | 3 (2.0%)   | 31 (7.4%)  |
| Electric Shock                       | 1 (0.7%)   | 0          |
| Burns                                | 0          | 4 (0.9%)   |
| Total Number of Claims               | 152        | 420        |

\*Based on all the claims processed by one insurance broker specializing in insurance for the industry. Data given for tallies made for two periods of time.

It is significant, I think, that chemicals are claimed to be the cause of so few of our injuries. This can be attributed in great part to the general recognition of the potential of chemicals for injury. This has been a part of the industry's training. Some effect may be attributable to the use of protective devices where hazards are recognized. Whatever the reason, there is no indication here of an acute problem from exposure to pesticides.

Another observation that I would make from my experience is that the majority of our problems with pesticides come as a result of accidents rather than from an accepted normal application procedure. Examples that I would cite are a bursting hose, a service vehicle becoming involved in an accident, or a container bursting or leaking.



I feel compelled to protest vigorously the propagation of the concept that all pesticides are extremely hazardous to handle, that all workmen have to wear protective clothing to apply any pesticides, and that the use of protective clothing and equipment ensures safety in handling pesticides.

We hope that your Panel can help maintain an objective evaluation of the safety needs of all pesticide users, including our industry.

Ralph E. Heal  
Executive Secretary  
National Pest Control Association

Enclosures

## CHECKLIST OF SAFETY EQUIPMENT

### For General Pest Control

- 1) First-aid kit with instructions for use. Name, address and phone number of company doctor or Poison Control Center.
- 2) Fire extinguisher
- 3) Flashlights with extra batteries and bulbs
- 4) Dome light over chemicals and equipment in vehicle
- 5) Racks to store material and equipment
- 6) Unbreakable and impervious containers for pesticides—labelled in accordance with TR 15-66
- 7) Proper bait trays or stations in accordance with Rodent Committee recommendations
- 8) Proper measuring devices for/or premeasured concentrate  
Proper measuring devices for chemicals and/or labelled containers with premeasured amounts
- 9) Clean water in clean containers for washing in case of accident or diluting emulsifiable concentrates
- 10) Soap and towels
- 11) Wiping rags
- 12) Coveralls (plus extra set)
- 13) Gloves—throw away plastic or reusable type and head net
- 14) Plastic or cloth foot covers—protective galoshes, etc.
- 15) Safety goggles or face shields
- 16) Bump caps—non metallic
- 17) Dust mask
- 18) Proper mask or respirator for particular job
- 19) Grounding device (or double-insulated tools)
- 20) Three-wire extension cord
- 21) Stepladder or small stool
- 22) Clean-up materials for wet and dry spills

Revised by NPCA Operations Committee - 1971

## **CHECKLIST OF SAFETY EQUIPMENT**

### **For Bird Management**

- 1) First-aid kit with instructions for use. Name, address and phone number of company doctor or Poison Control Center.
- 2) Fire extinguisher
- 3) Racks to store materials and equipment
- 4) Dust respirators
- 5) Flashlight and extra batteries and bulb
- 6) Spotlight
- 7) Gloves
- 8) Rope to rope off areas beneath workmen
- 9) "Men Working" signs
- 10) Non-skid ladders-preferably wood
- 11) Ladder jacks or hooks to secure ladder at top against wall or roof
- 12) Safety rope with belt or harness
- 13) Non-skid shoes
- 14) Non-metallic hard hats
- 15) Sprinkling can or hose to water dusty areas
- 16) Soap and towels
- 17) Face shields or safety goggles for eyes
- 18) Broom or wire brush and putty knife
- 19) Dustpan
- 20) Container for debris and trash
- 21) Clips on ladder to secure tools
- 22) Rope pulley for hoisting materials
- 23) Bird repellent solvent
- 24) Coveralls
- 25) Electrical grounding device
- 26) Three-wire extension cords

Revised by NPCA Operations Committee - 1971

## **CHECKLIST OF SAFETY EQUIPMENT**

### **For Subterranean Termite Control**

- 1) First-aid kit with instructions for use. Name, address and phone number of company doctor or Poison Control Center.
- 2) Fire extinguisher
- 3) Flashlight with extra batteries and bulb
- 4) Soap and towels
- 5) Wiping rags
- 6) Coveralls (plus extra set)
- 7) Signs and bridges for hoses laid across sidewalks
- 8) Non-metallic hard hats or bump hat
- 9) Goggles or face shields
- 10) Safety goggles
- 11) Three-wire extension cords
- 12) Grounding devices
- 13) Plastic-coated fabric gloves for electrical protection
- 14) Respirators—dust masks
- 15) Snake-bite kit
- 16) Drop cloths or tarps
- 17) Electrical tape
- 18) Water-shut-off key
- 19) Rubber soled shoes—chemical
- 20) Pocket knife
- 21) Filling hose with check-valve
- 22) Vacuum breaker to prevent backflow of water into customer's system
- 23) Ear protection devices
- 24) Clean-up materials for wet and dry spills
- 25) Slater grounding monitor or equipment

Revised by NPCA Operations Committee - 1971

**PANEL NO. 6: ACTIVITIES FOLLOWING USE—  
DECONTAMINATION AND DISPOSAL, FIELD RE-ENTRY**

**A. Decontamination** There are four major aspects of decontamination related to the use of protective clothing and safety equipment.

1. *Decontamination of concentrate spills or dumps.* Research is needed to determine and satisfy special requirements for protective clothing and safety equipment capable of preventing harm from heavy exposure to concentrates, as distinguished from clothing and equipment adequate for use with concentrations normally encountered in field use.
2. *Decontamination of work contact surfaces.* Research is needed on work surface decontamination, a promising but practically unexplored method of reducing or eliminating needs for use of protective clothing and safety equipment by workers entering treated areas.
3. *Decontamination of protective clothing and safety equipment.* Specifications for decontamination of protective clothing and safety equipment need to be developed, and the information widely dispersed, to reduce or eliminate protective clothing and equipment as a source of exposure.
4. *Decontamination of exposed workers.* Methods for decontamination of exposed workers need further investigation, in part to resolve conflicting appraisals of the value of bathing. Worker decontamination procedures should be regarded as supplementary or emergency measures, and not substitutes for proper protective clothing and safety equipment or adequate re-entry safety intervals.

**B. Disposal.** Needs for protective clothing and safety equipment during disposal of surplus pesticides are similar to those for handling pesticide concentrate spills and dumps. In disposal of containers, protective clothing and safety equipment requirements are similar to those for protection from field concentrations of pesticides, except that a greater degree of protection may be required where thermal treatment is used in conjunction with disposal. Thus research needs in this area are non-specific with respect to protective clothing and safety equipment. However, research directed toward improving or providing alternatives to present disposal methods could reduce potential exposures and thereby lessen dependence on protective clothing and equipment.

**C. Re-entry.** Unprotected workers who must enter areas treated with pesticides may be protected from undue risk of harmful exposure to airborne pesticides and surface residues of pesticides by being prevented from entering treated areas while pesticides remain in potentially harmful kinds and quantities. Within these "re-entry safety intervals," however, there may be subperiods during which unprotected workers might safely enter to engage in activities involving negligible exposure, or during which workers might safely enter if provided with partial protective clothing and safety equipment.

In order to determine re-entry safety intervals for various activities of unprotected or partially protected workers, it is necessary to obtain information as to the persistence and availability of airborne pesticides and surface residues of pesticides with the passage of time after application, the probability of exposure to the pesticides in the course of various activities in treated areas, and the significance of exposures which might occur. Present knowledge in this area is rudimentary.

Effective means are needed for informing pesticide users of intervals during which various activities in treated areas require protective clothing and safety equipment.

**D. Research.**

1. Specifications should be developed, through testing and certification, for protective clothing and safety equipment adequate for protection from exposure to both heavy concentrations and dispersed residues of pesticides.
2. Communications and motivational analyses should be applied to improving the effectiveness of directions for use of protective clothing and equipment.
3. Inexpensive, readily available methods and materials should be developed for detection and measurement of pesticide exposures in man, both as an aid in establishing standards for use of protective clothing and safety equipment and as a means of monitoring their effectiveness.



4. Methods and materials should be developed for decontaminating surfaces contaminated by pesticides, in order to foreshorten, downgrade, or eliminate the need for using protective clothing and safety equipment in treated areas.
5. Specifications should be developed, through testing, for adequate methods and materials for decontaminating protective clothing and safety equipment.
6. Existing, suggested procedures for decontaminating persons exposed to pesticides as a result of failure to use adequate protective clothing and equipment, safety equipment should be re-examined, adding emphasis on protection of persons performing the decontamination.
7. Criteria should be developed for measuring the persistence and availability of pesticide residues, the extent of exposure to such residues in various post-application activities, and the significance of such exposures, to aid in determining intervals after pesticide application during which protective clothing and safety equipment must be used in treated areas.
8. Research should be conducted in such areas as promise to provide alternatives or adjuncts to protective clothing and safety equipment as used in decontamination, disposal, and field re-entry.

**E. Alternative practices.** Protective clothing and safety equipment should be used where there is unavoidable exposure to pesticide hazards during decontamination, disposal, or field re-entry. In the alternative, either the exposure of or the hazards, or both, must be reduced.

1. Training and performance in handling pesticide concentrates can be improved, to reduce the incidence of spills and dumps.
2. Reduction of container contamination by rinsing, as suggested by NACA, should be encouraged.
3. Application equipment and techniques and pesticide formulations can be improved to reduce contamination of the worker's environment.
4. Exposures to field residues can be reduced by carefully integrating pesticide applications with other necessary field operations.

**F. Information dispersal and gathering.**

1. Continued use should be made of existing and improved educational programs, to make pesticide users and others in contact with pesticides aware of safety measures.
2. Readily understandable lists of acceptable protective clothing and safety equipment should be distributed and kept up-to-date.
3. Establishment of a national central information center should be considered, for the purpose of providing technical assistance to the public on pesticide safety. This center could also function as a collection point for data on pesticide accidents and morbidity reports.
4. Information applicable to the subject area of protective clothing and safety equipment should be sought actively from outside sources such as NTIS, GPO, DOD, Foreign governments, and industrial producers and users of toxicants other than pesticides.

**G. Regulations**

1. Minimum performance standards for protective clothing and safety equipment should be established. These should include provisions for certification of clothing and equipment.
2. Entering, or causing persons to enter treated areas without adequate protection from exposure to harmful residues should be prohibited. Such regulations should require observance of established re-entry safety intervals.
3. Where necessary to assure proper use of protective clothing and safety equipment, pesticide sales and use should be restricted by regulation to licensed or certified users.

**COMMENTS PROVIDED  
FOLLOWING THE CONFERENCE**

**EFFECTS OF DIFFERENT KINDS OF EXPOSURES ON MAN AS  
DETERMINED THROUGH LABORATORY TESTING.**

**John E. Davies, M.D., M.P.H.**

**Department of Medicine  
University of Miami  
Miami, Fla.**

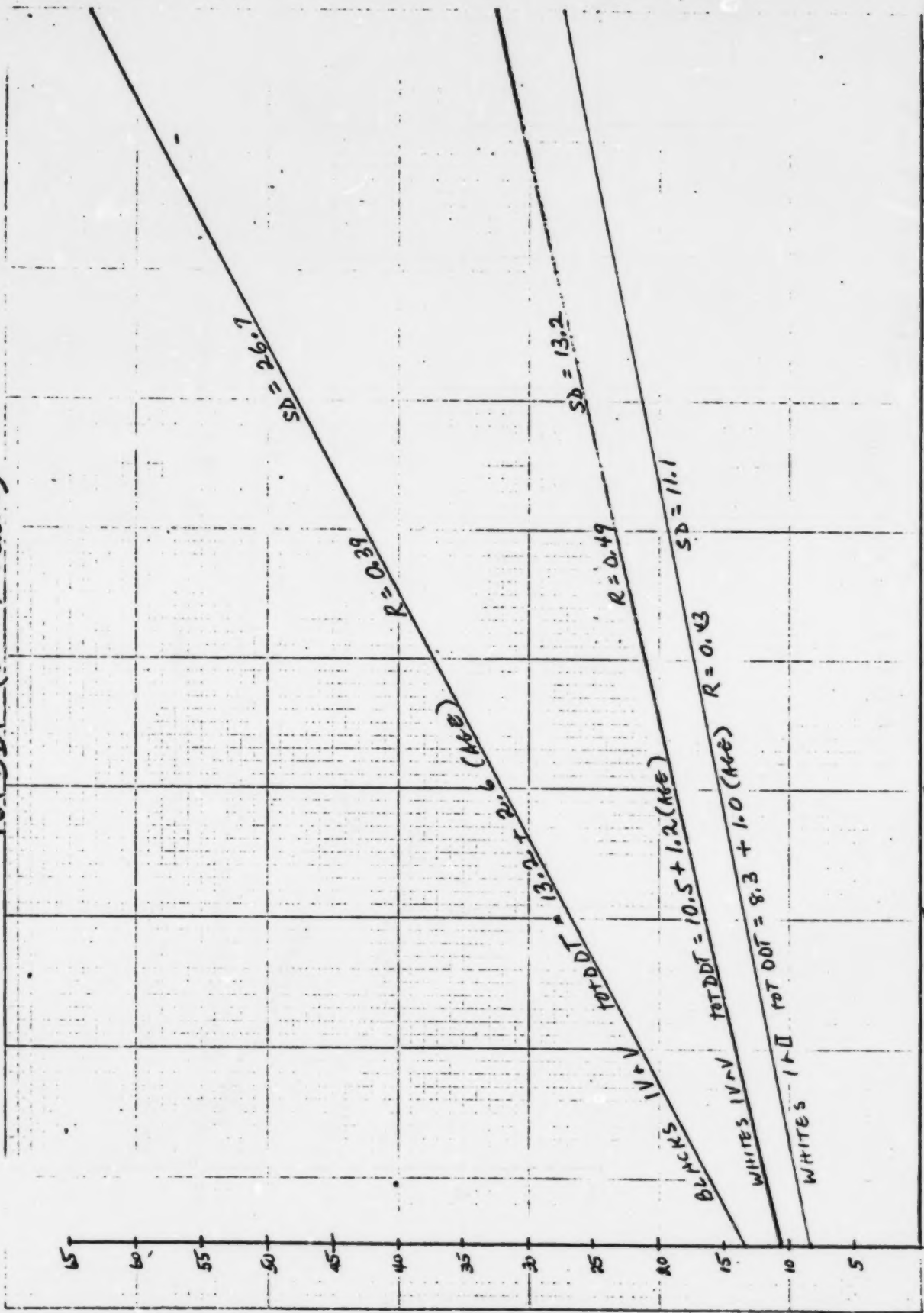
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**DADE COUNTY - 1965**8/24/65

THE CHAMPION LINE NO 642  
CROSS SECTION - 10 SQUARES TO INCH

27 17 = 44.16 ± 0.16  
65 17 = 44.16 ± 0.16  
94 17 = 44.16 ± 0.16

TOTDDT (0-19 Years)



TOTDDT 153

Age 1-1.001

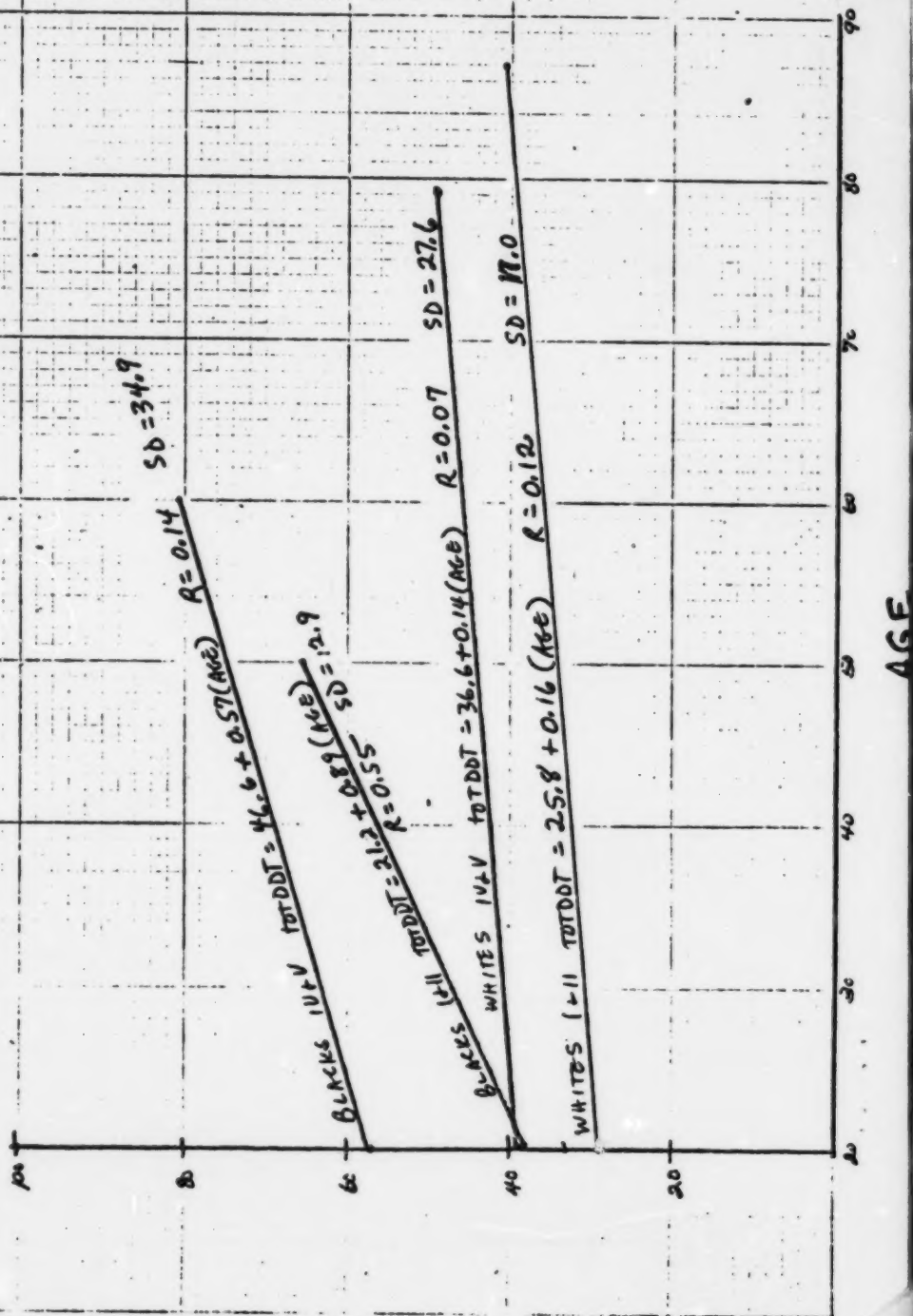
2.72



161 WHITES I and II  
 164 WHITES III and IV  
 26 BLACKS I and II  
 164 BLACKS III and IV

TOT DDT (20+ Years)

100' STATION LINE TO 642  
 100' STATION LINE TO 504 5 TO INCH



## THE USE OF PROTECTIVE CLOTHING AND EQUIPMENT FOR PREVENTION OF EXPOSURE TO PESTICIDES

by

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The potential hazard of toxic pesticides to workers who come in contact with such compounds has long been recognized. However, even the more toxic pesticides recommended for use today can be used safely if reasonable precautions are taken to prevent excessive exposure. Unfortunately, such precautions have not always been followed, and, as a result, poisoning in workers during occupational exposure to toxic pesticides has occurred.

The importance of dermal exposure, and, thus, the need for adequate protective clothing, has been recognized for several years. Davies *et al.*,<sup>1</sup> in studying spraymen exposed to parathion, observed that when a worker had begun to limit his exposure by wearing coveralls, gloves, and rubber boots, significant positive correlation between urinary excretion of *p*-nitrophenol and quantities of parathion used was no longer apparent. Summerford *et al.*<sup>2</sup> noted examples of definite symptomatic improvement in the face of continued exposure following adoption of protective clothing by workers applying organophosphorus pesticides. Research at this laboratory has shown that the potential exposure of workers in formulating plants to wettable powder DDT would be 2½ to 10 times greater if they did not wear recommended protective gear.<sup>3</sup>

The fact that the skin is subjected to a higher dose than the lungs has been noted in many work situations studied by direct and indirect methods at this laboratory<sup>4-6</sup> and by other investigators.<sup>8-10</sup> In investigations of parathion poisoning in Florida citrus spray operations, Williams and Griffiths<sup>11</sup> concluded that absorption through the skin was probably the most common route of entry for parathion into the body. Hayes<sup>12-13</sup> pointed out that the measured dermal exposure of spraymen is adequate to account for the majority of cases of occupational poisoning by many pesticides and that measured respiratory exposure is inadequate to explain such results.

It is recognized that chemicals given at equivalent doses are absorbed more rapidly and more completely from the respiratory tract than through the skin and that studies with volunteers revealed a lack of toxic effect from large dermal doses of parathion.<sup>14</sup> However, parathion applied to the skin of laboratory animals has shown high toxicity.<sup>15-16</sup>

The importance of respiratory protection should not be minimized, however. The respiratory route of exposure is of increased importance where vapors, extremely fine spray droplets, and dry pesticide formulations such as dusts or wettable powders are involved. In the various pesticide application situations studied at this laboratory<sup>4</sup> the average potential respiratory exposure tended to be higher in agricultural dusting operations than during agricultural spraying operations.

Laxity, negligence, or downright carelessness can be factors in exposure regardless of the protective devices being worn. Also, an excessively exposed worker may not be completely at fault if he is not adequately warned of the necessity of protection when working with certain toxic compounds.

Although pesticide labels provide recommendations for protective clothing and equipment to be used with each specific pesticide, there is very little published data available on the necessity for, or effectiveness of, this equipment. The purpose of this paper is to discuss the role of protective clothing and equipment and their use under actual field conditions, as well as to report results of studies conducted to evaluate the effect of such protection in reducing exposure to pesticides.

### MATERIALS AND METHODS

The Wenatchee Research Station is located in North Central Washington on the grounds of the Washington State University Tree Fruit Research Center. The laboratory has been carrying out pesticide research since 1951 and a high degree of cooperation by the researchers and the industry has been built up over the years. The station staff has extensive experience with studies and observations of spray practices, especially in the Pacific Northwest. The study group was made up primarily of orchardists and row-crop farmers who carry out their own pesticide application

operations. Most of the observations concerning use of protective gear were on workers applying pesticides to fruit orchards. The authors feel that the data presented generally reflects the typical protection employed by such workers.

Estimation of the amounts of pesticide workers potentially would be subjected to while using different kinds of protective clothing and devices during exposure followed the techniques and procedures described by Durham and Wolfe.<sup>17</sup> Potential dermal contamination was measured primarily by attaching absorbent *g*-cellulose pads for spray exposure, or layered gauze pads for dust exposure, to various parts of the worker's body or clothing and allowing them to be exposed during a period of spraying or dusting. Contamination of hands was measured either by rinsing in a solvent in a polyethylene bag or by swabbing with solvent-impregnated gauze swabs. Respiratory exposure was estimated from the contamination of filter pads of special single- or double-unit respirators and/or air concentration values determined by use of impinger-type air samplers. All pads were extracted with the proper solvent in a Soxhlet apparatus. Parathion samples taken earlier in the study were analyzed by the method of Averell-Norris<sup>18</sup> and later samples for parathion, as well as for ethion and endosulfan, were by gas-liquid chromatography. Chemical analysis for azinphosmethyl was by the method of Meagher *et al.*<sup>19</sup>

### RESULTS AND COMMENTS

The greatest need for protection from dermal exposure is while applying liquid sprays with equipment that forces large quantities of dilute spray upward into the air where it may easily drift onto the operator. Power air-blast machines used to apply dilute liquid spray to fruit orchards are good examples of this type of equipment. Presented in Tables 1 and 2 are data resulting from a study during a two-year period on the use of protective clothing and devices by spraymen while applying a commonly used toxic pesticide, parathion, in fruit orchards with this type of spray equipment. Even though many compounds used in orchards are much less toxic than parathion, our observations have been that the amount of protective clothing or devices worn while spraying with such compounds is about the same as when using parathion. An exception is that the worker will more frequently wear an approved respirator when he is spraying parathion than when he is using a less hazardous material. When spraying in orchards with compounds more toxic than parathion the amount of protection is again about the same, however, the practice of wearing an approved respirator is even more strictly adhered to. The few exceptions are pointed out in the discussion of each protective item.

The time of year referred to as the "cooler period" was during March, April and May when temperatures rarely rose above 65°F and the period referred to as the "warmer period" was during June, July and August when temperatures were generally much warmer and occasionally rose above 90°F. Fifty-three observations were made of spraymen during the cooler period and 53 during the warmer period. Observations were also made on spraymen applying compounds other than parathion. Additional comments on protective gear are based on observations during several hundred exposure studies conducted over a ten-year period in the Pacific Northwest.

**Respiratory Protection.**—As can be seen in Table 1, much less than one-half of the group applying parathion wore respirators even though the pesticide labels stated that an approved respirator should be worn. Of those spraying during the cooler period, 30.2% wore respirators and during the warmer period only 24.5% wore them. It has been observed that spraymen occasionally wear respirators during loading only, or during spraying only, however, it will be noted that in the present study most of the men who wore respirators wore them during both spraying and loading. In between these two activities the mask is usually pulled down and allowed to hang around the neck for short periods, such as for smoking a cigarette. On occasions a sprayman may be found who also pulls the mask down to a hanging position around his neck during short periods when he feels that spray drift is negligible. He may do this primarily for relief from discomfort of the mask. In such cases the mask may become contaminated to some extent inside the face-piece. Fortunately, this is the exception rather than the rule. An occasional individual may be found who wears a respirator merely to reduce allergic reaction, not just from the spray but from ragweed, grasses or other plants in orchard areas.

When spraying with compounds less toxic than parathion, respirators are rarely worn. Observations of 32 azinphosmethyl, 29 diazinon or ethion, 3 malathion, 12 carbaryl, 9 perthane, 8 dieldrin, and 13 DDT exposure situations revealed that five who were spraying azinphosmethyl, one who was spraying dieldrin, and four who were spraying DDT wore respirators and the rest wore none.

Of compounds more toxic than parathion, observations of spraymen in orchards using mevinphos, TEPP, and demeton indicated that in practically every instance respirators were worn. Several using mevinphos complained of slight illness and at least one of these men was known to have been using a respirator not approved for protection against that compound.



Respirators are usually worn during exposure to pesticide dusts. A study of 11 men operating ground dusters applying parathion or endrin in potato and strawberry fields showed that all wore approved respirators during all phases of dusting operations. Although this is probably aided by their knowledge that the potential hazard from respiratory exposure to dusts is considered greater than from exposure to sprays, the mere irritation of the respiratory tract from dusts is no doubt also an important factor in causing workers to more faithfully wear respirators during exposure to dusts. In a study of 17 pilots of fixed-wing aircraft and 7 helicopter pilots applying pesticides, 20 wore respirators during dusting applications with organophosphorus compounds. However, when applying liquid sprays only 13 wore respirators and then only when applying compounds as toxic as parathion. Pilots are generally more cautious about respiratory protection; in fact, 7 of the 24 in the study used canister-type filters which give more protection than the filters mounted on face masks. A few pilots used filter canisters attached inside the cockpit with a device for quickly connecting or disconnecting the hose to the face mask. This system was reported to be much more convenient than wearing the canister at the waist, attached to the belt.

A study of 4 pilots who were applying parathion to row crops indicated that oral contamination may result from not wearing a respirator during pesticide application. Saliva samples were taken from two pilots who had worn the canister-type respirator. Analyses of the samples did not reveal detectable amounts of parathion. On the other hand, analyses of samples taken from two pilots who had not worn respirators showed 23.5  $\mu\text{g}$  and 17.7  $\mu\text{g}$  of parathion, respectively, in the saliva.

Flaggers and loaders, as well as airplane or helicopter pilots, taking an active part in dusting operations with most compounds were rarely observed without protection from a respirator.

Repeated observations of workers in six pesticide formulating plants in the Pacific Northwest throughout 4 seasons failed to reveal any great laxity in wearing respirators while working with organophosphorus pesticides. During exposure to less toxic compounds, however, respirators were not always worn. It is not uncommon to find workers bagging the wettable powder or dust formulations of carbaryl, or certain other pesticides considered "not very toxic," without the use of respirators.

Workers in orchards, such as fruit thinners who come in contact with toxic spray residues, rarely wear respirators or dust masks of any kind even though there is some evidence that such workers under certain conditions probably should be provided with respiratory protection. Workers thinning apples during the spraying season have become poisoned when working in orchards relatively soon after pesticide application.<sup>20</sup> Handling of the immature fruits and agitation of foliage usually causes particulate matter to be present in the air at the breathing zone. This is particularly true where much inert material is present as a result of application of wettable-powder pesticide formulations. Analysis of air near the breathing zone of a thinner working in the orchard 72 hours after application of parathion showed 0.049 mg of parathion per cubic meter of air.<sup>21</sup> On the basis that such an individual is doing only light work, the respiratory exposure could be calculated as 0.085 mg/hr, which is four times as much respiratory exposure as has been calculated for spraymen who apply parathion to orchards.<sup>22</sup> If the respirators are recommended for application of the spray, it seems that they should also be used during the thinning operation unless more than 72 hours have elapsed since spray application. Present unofficial recommendations in the Pacific Northwest are that thinners should not work in orchards until at least 48 hours, and preferably 72 hours, after spray application of parathion. Unfortunately, this recommendation has not always been followed and such might have been the case in certain instances where poisoning has occurred. Thinners have been observed working in orchards as soon as the parathion spray had dried on the foliage, and none were wearing respirators. Questioning of one worker found wearing a respirator while thinning fruit revealed that he used it merely to reduce allergic reaction.

One problem concerning the use of respirators does not seem to be clear to a large proportion of workers exposed to toxic pesticides. This is the problem of how often to change respirator cartridge filters or filter pads. The U.S. Department of Agriculture has made specific recommendations concerning the use and care of respirators.<sup>23</sup> A survey of label warning statements on organophosphorus pesticide containers in warehouse stock showed that, of those stating that a respirator should be worn, none contained a statement about how often the filter cartridges or filter pads should be changed. The statements on the labels concerning respiratory exposure are usually very little more than "do not breathe spray mist, vapor or dust and wear a mask or respirator of a type passed by the U.S. Department of Agriculture." Perhaps additional information on the label may not be necessary if it is covered properly in safety statements found in various pesticide application recommendation pamphlets and bulletins provided by state and federal agencies or other groups who are responsible for such recommendations. However, on investigation of a number of such recommendations, it was found that very few include more than the statement, "Wear a mask or respirator of a type passed by the USDA." Occasionally, the statements "change filters and filter pads at regular

intervals" or "change filters and clean respirators daily" may be found. For the sprayman who is exposed to toxic compounds intermittently rather than for full work days, these statements leave much to the individual in determining when his respirator has reached the point of losing efficiency. Instruction sheets enclosed with new respirators or in filter cartridge cartons have been found to include more complete instructions concerning care and use of respirators, however. It should be the employer's responsibility to see that any pesticide applicator employee has read such information.

Inquiries of spraymen in orchard areas of the Pacific Northwest revealed that they often cannot remember exactly when they last replaced the respirator filter cartridges. Because of only intermittent spray operations the respirator is usually neglected until it appears extremely contaminated or until the individual senses excess pesticide odor or restricted air flow. A few orchard spraymen who apply toxic pesticides during three or four short periods throughout the spring or summer seasons change filters or pads only between each spray period. Each period of spraying usually covers three to four days. Sometimes, due to poor spray conditions, this extends into five or six part-days. The time between periods may be two to three weeks.

In a study of respiratory protection of operators of tractor-mounted boom dusters applying parathion to row crops, most of the workers reported they changed respirator filters and pads each day even though dusting operations rarely totaled more than four hours. In this type of application the operator may often pass through heavy layers of dust held near the ground by air inversions. Under such conditions visible contamination of the respirator becomes so evident that it is not surprising that the operator becomes aware of the need for changing filters more often than when applying liquid sprays. This need was emphasized by Wolfe *et al.* who calculated the potential respiratory exposure while dusting row crops with parathion under these conditions to be 0.16 mg/hr of dusting operations. This was considerably more than the potential respiratory exposure of <0.01 mg/hr calculated for workmen applying liquid parathion spray to the same crops with tractor-mounted spray boom machines.

Workers in pesticide formulating plants are more faithful in care of their respirators. This is probably influenced by the fact that they are usually under more strict supervision concerning such matters as contamination with toxic pesticides. Such workers also wash the inside of the face-piece more often than do spraymen in the field.

Headgear may provide some respiratory protection where downward drift of pesticide is involved. It seems reasonable to assume that at least a small amount of protection is provided by such items when worn during operation of air-blast machines. Other types of protective gear are occasionally tried by spraymen. One individual claimed that the helmet, visor and hood of a supplied-air respiratory assembly provides ample respiratory protection where highly toxic volatile material is not being used. He used it when spraying organophosphorus compounds throughout one spraying season and found it so satisfactory he used it each spray season thereafter. The complete supplied-air respirator, helmet, and hood system with tractor-mounted air supply blower and filter has been used to some extent when applying highly toxic pesticide dusts. Our observations indicate that such equipment is efficient in preventing respiratory exposure but not very acceptable in many cases because of some restriction on movement and visibility. Although there has been considerable improvement in respirator design during recent years, there is still considerable room for improvement. The main factors involved as far as acceptance by the worker is concerned is comfort in wearing and ease of respiration. Also, it would be desirable if a replaceable respirator cartridge could be developed that incorporates some type of indicator, possibly a color indicator, to show when the cartridge needs to be changed.

**Dermal Protection of Head-Face-Neck Area** - Good protection of the head-face-neck area from downward drift of pesticides is afforded by some type of wide-brimmed hat, preferably made of water-repellent material. As can be seen from the data presented in Table 2, nearly one-half the orchard spraymen studied wore this type headgear. There seemed to be no great change in this respect from the cooler to the warmer period, indicating that discomfort in hot weather is no great factor where spray drift is encountered. However, considering all other types of spraying or dusting activities, the headgear most frequently worn is the cloth billed cap. Such a cap protects the top of the head and gives some protection to the face but gives very little protection to the neck areas.

Waterproof hoods attached to jackets have found some use. Unfortunately, they are usually left hanging down behind the head until exceptionally heavy drift occurs. By that time the inside of the hood may be heavily contaminated. When a contaminated hood is pulled up over the head there is considerable potential for absorption of pesticide from rubbing of the hood against the skin of the face-neck area.

Four of the 53 orchard spraymen studied wore no headgear during the cooler period, and six more wore none later during the warmer weather. Fortunately, such practice of going bareheaded while working with pesticides is uncommon. No bareheaded individuals were noted among 11 workers applying dusts or sprays to row crops with ground equipment. Of 32 formulating plant workers studied during a three-year period, only two consistently worked bareheaded and only one of these worked at the bagging machine where contamination was greatest.



The use of goggles is a protective measure which not only provides good protection to the eyes but also gives a small amount of protection to the face area. It is interesting to note that even though labels on many toxic organophosphorus pesticide containers state that goggles should be worn, this practice is rarely followed by ground applicators. Even in formulating plants where eyes may easily become contaminated with dry pesticide, the wearing of goggles is an uncommon occurrence.

Questioning of pesticide application pilots has revealed that they wear goggles not only to prevent poisoning and to keep wind out of the eyes but also to prevent pesticides that are direct inhibitors of cholinesterase from causing miosis. This is understandable because it has been shown that unilateral contamination of the eye with such a compound may cause pilots to inadequately judge distance.<sup>24</sup> The incoordination which may accompany this could be a serious threat to safety.

In our opinion the greatest need in relation to protective gear for the face-neck area is a wide-brimmed waterproof hat without a cloth lining or leather sweat band. Cloth linings and leather sweat bands become badly contaminated with extended use and are not easily cleaned. Ear flaps on hats are also difficult to clean. Another problem with ear flaps is that when they are folded up into the hat they do not allow enough room for comfortable wearing of respirator straps over the head. This leads to either not wearing a respirator or to the wearing of a billed cap so that respirator straps can be placed over the top of the cap.

Dermal Protection of the Upper Trunk and Arms.—Protection of the upper trunk and arms from contamination by toxic pesticides is important, especially in heavy spray drift which may thoroughly wet thin cloth shirts, coveralls, and underclothing. The areas of greatest contamination were found to be the upper back, shoulders, and arms. As can be seen in Table 2, only 9 cases of the 53 exposures of orchard spraymen studied involved the minimum protection of a tee-shirt or short-sleeved open-necked sport shirt. These were worn without undershirts. All the rest involved items of clothing which gave some protection to the arms as well as the upper trunk. In 51.9% of the exposure situations studied, protective over-clothing such as cloth or rainproof jackets or coats were worn. Needless to say, the greatest protection is from rainproof garments which cannot be penetrated by spray but are understandably somewhat uncomfortable to wear during hot weather.

In order to determine any change in practices of wearing protective clothing which might possibly be attributed to discomfort because of higher temperatures, 15 of the spraymen who were studied during the cooler period were observed later during the warmer period. Of the fifteen, 8 who were wearing waterproof jackets or raincoats during the cooler period changed to more comfortable attire during the warmer period. In most cases the change was to less protection. One of the men changed to a cloth jacket but the remaining 7 changed to either long- or short-sleeved shirts. Three of the 15 wore coveralls or long-sleeved shirts as outer clothing during both periods. One individual changed from coveralls to a thin short-sleeved cotton shirt with no underclothing, providing somewhat less protection from exposure.

Data based on all individuals studied indicate that spraymen generally provide less protection to the upper trunk and arms during warmer summer months. During the cooler period 86.8% of the spraymen wore clothing providing more protection than a plain long-sleeved cotton shirt as the outer garment. During the warmer period only 49.1% of the spraymen provided that much protection. Discussions with many spraymen have revealed that heavy outer garments such as waterproof jackets and trousers are almost unbearable at times during hot weather and only those most fearful of pesticide poisoning endure the wearing of such garments.

On the basis of these findings one can, therefore, assume that temperature leading to discomfort is a factor in the decision by a sprayman as to whether or not to wear extra clothing for protection against toxic pesticides regardless of any protective clothing recommendations he might have read on the pesticide label.

Although in actual practice spraymen wear less protective clothing in hot weather than in cool weather this may be just the opposite of the procedure that should be followed. It is true that more pesticide applications take place in warmer weather and thus more poisonings would be expected to occur under such conditions. However, there is evidence that hot weather may be an actual contributing factor in poisoning aside from the consideration of increased frequency of exposure. Thus, it has been shown by Funckes *et al.*<sup>14</sup> that parathion is absorbed through the skin more rapidly and more completely during conditions of higher temperatures. Also, Baetjer and Smith<sup>25</sup> have reported that parathion is more toxic to mice at higher environmental temperatures.

Although the effect on absorption of pesticides by covering contaminated skin with specific items of waterproof clothing is not known, it is certainly sound advice to put on protective gear before the skin has been contaminated.

Although a variety of waterproof jackets and trousers are available commercially and some are manufactured especially for use by pesticide applicators, we feel that certain improvements would be helpful in prevention of exposure as well as to make the items more acceptable when working under high temperature conditions. A limited

number of tests at this laboratory indicates that temperature at the skin surface may be 10°F lower where a white waterproof jacket is worn under sunny 81°F-83°F conditions vs. the wearing of a black jacket of approximately the same weight material. Comments from pesticide applicators indicate that lightweight protective clothing is much more comfortable, and thus more acceptable, than those made of heavy weight material. As one worker stated, "If they are heavier they are not flexible enough to allow free movement and they seem hotter if they are heavy, even though it may all be psychological." Jackets we have checked weighed from ½ lb. to over 3 lbs. The lighter weight jackets may wear out sooner but they cost less to replace.

Any type of cloth lining of a jacket or trousers is not desirable because of the difficulty in cleaning. Many lightweight waterproof jackets are available, however, most have some type of cloth lining of the collar.

In consideration of the above, the availability of a relatively lightweight waterproof protective jacket or trousers with highly reflective surface, and no cloth lining, may be most desirable from the standpoint of protection as well as acceptance by the worker.

**Protection of Hands.**—The hands are best protected by use of unlined rubber gauntlet gloves. The gauntlet covers the wrist area not normally covered by a jacket sleeve. Unlined gloves are relatively easy to clean on the inside, whereas, cloth-lined gloves are almost impossible to adequately decontaminate. The problem of acceptance of various types and weights of gloves by workers is somewhat the same as noted above for jackets and trousers.

The warning statement on certain pesticide labels recommends the wearing of natural rubber gloves, and in a few cases the statement, "wear heavy natural rubber gloves," appears. Heavy weight gloves, although durable and practically nonpenetrable by highly toxic pesticide compounds, do not allow adequate freedom of movement, especially finger flexibility. This leads to removal of gloves at times when they are most needed, e.g., when adjusting a heavily contaminated spray machine engine or tearing open a paper bag of wettable powder pesticide. Very light grade gloves are also not particularly desirable. They wear thin under constant use and thus are more susceptible to penetration by toxic pesticide. Also, most thin rubber gloves are very uncomfortable to wear in hot weather because of the build-up of perspiration and accompanying uncomfortable "clinging effect" to the fingers. Therefore, it is advisable to secure gloves of a grade that is somewhat durable but yet light enough to be flexible, and thus more acceptable to the worker.

**Protection of Feet.**—Our observations of a great many pesticide exposure situations lead us to believe that waterproof shoes or boots should be worn when handling or applying pesticides on a large scale. This is especially important where liquid spraying in the field is concerned because invariably the ground cover of weeds, grasses or other plants becomes wet with dilute pesticide regardless of whether or not they are the target of application. Even the operator of a tractor pulling power spray equipment will walk in such ground cover enough to wet his shoes. Research at this laboratory shows that leather shoes exposed repeatedly to liquid sprays have a tendency to become cracked and dried out to the extent that measurable amounts of pesticide easily penetrate through to the sock or foot.

**Exposure of Operators of Air Blast Spray Equipment.**—Table 3 shows the calculated potential dermal exposure to parathion for workers spraying orchards with high-volume dilute air blast equipment. The values for different exposed body parts reflect the average exposure for such workers. These values are based on the assumption that the workers wore short-sleeved, open-necked shirts, no gloves or hats, and that the clothing worn gave complete protection of the areas covered. This amount of clothing was elected since it represents just about the smallest amount of protection which was observed in the field under most exposure conditions. The values obtained indicate that, on the average, the forearms are the area of greatest contamination. A potential of 9.5 mg of parathion per hour on this area certainly warrants the use of long-sleeved protective clothing. Although the average exposure for hands is a bit lower (3.9 mg/hr) than for the arms, exposure in this area is occasionally exceptionally high because of contact with concentrate material during mixing or loading. The 4.9 mg/hr value for the face area when not wearing a cap or hat indicates the need for the wearing of headgear which prevents drift of pesticide onto the head-face-neck area. If a wide-brimmed hat, jacket and gloves were worn the potential exposure would be reduced considerably.

Table 4 shows potential dermal exposure values for applicators applying three different pesticide compounds. Potential exposure based on actual protective clothing worn is compared with potential exposure that could have occurred had the workers been provided with only a minimum amount of protection. The calculations indicate that the wearing of at least some additional protective gear has reduced potential exposure considerably.

In conclusion, the importance of dermal and respiratory exposure certainly warrants the use of some type of protective gear. Many items are unbearably uncomfortable to wear during hot weather, therefore, they are not very acceptable to the worker. Improvements in protective equipment are needed in order to bring about better acceptance and thus better protection of workers.

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**Table 1.—Respiratory Protection of Workers Operating Air-Blast  
Spray Machines Applying Parathion to Fruit Orchards  
in Central Washington**

| Respirator Use              | No. of Observed<br>Exposure Situations |                                  |
|-----------------------------|----------------------------------------|----------------------------------|
|                             | Cooler Period<br>(Mar-Apr-May)         | Warmer Period<br>(June-July-Aug) |
| No respirator worn          | 37                                     | 40                               |
| Respirator worn             | 16                                     | 13                               |
| during spraying and loading | 16                                     | 11                               |
| during spraying only        | 0                                      | 0                                |
| during loading only         | 0                                      | 2                                |

**Table 2.—Dermal Protection of Workers Operating Air Blast Spray Machine  
Applying Parathion to Fruit Orchards in Central Washington**

| Body Area and Protective<br>Clothing Worn    | No. of Observed<br>Exposure Situations |                                  |
|----------------------------------------------|----------------------------------------|----------------------------------|
|                                              | Cooler Period<br>(Mar-Apr-May)         | Warmer Period<br>(June-July-Aug) |
| <b>HEAD-FACE-NECK-AREA:</b>                  |                                        |                                  |
| No protection                                | 4                                      | 6                                |
| Some protection                              | 49                                     | 47                               |
| cloth bill and cap                           | 21                                     | 24                               |
| brim hat                                     | 25                                     | 23                               |
| rubberized                                   | 18                                     | 15                               |
| felt                                         | 6                                      | 6                                |
| tropical helmet or hard hat                  | 1                                      | 2                                |
| rain hood                                    | 3                                      | 0                                |
| goggles                                      | 0                                      | 0                                |
| <b>UPPER TRUNK AND ARMS:</b>                 |                                        |                                  |
| Tee-shirt only                               | 0                                      | 2                                |
| Short-sleeved sport shirt                    | 0                                      | 7                                |
| Long-sleeved shirt                           | 7                                      | 18                               |
| Sweatshirt                                   | 1                                      | 1                                |
| Coveralls                                    | 10                                     | 5                                |
| Cloth jacket                                 | 13                                     | 6                                |
| Waterproof jacket                            | 20                                     | 14                               |
| Long slicker or raincoat                     | 2                                      | 0                                |
| <b>HANDS:</b>                                |                                        |                                  |
| No gloves worn                               | 26                                     | 34                               |
| Gloves worn                                  | 27                                     | 19                               |
| spraying and loading                         | 24                                     | 17                               |
| spraying only                                | 1                                      | 0                                |
| loading only                                 | 2                                      | 2                                |
| Type of Gloves:                              |                                        |                                  |
| cloth                                        | 3                                      | 0                                |
| leather                                      | 7                                      | 6                                |
| rubberized with cloth knit top               | 8                                      | 9                                |
| rubber gauntlet                              | 9                                      | 4                                |
| <b>LOWER BODY AND LEGS:</b>                  |                                        |                                  |
| No greater protection than cloth trousers    | 36                                     | 42                               |
| Partly protected by long slicker or raincoat | 2                                      | 0                                |
| Waterproof trousers                          | 15                                     | 11                               |
| <b>FEET:</b>                                 |                                        |                                  |
| No greater protection than leather shoes     | 11                                     | 18                               |
| Rubber boots                                 | 16                                     | 5                                |
| No record taken                              | 26                                     | 30                               |



**Table 3.—Potential Dermal and Respiratory Exposure to Parathion While Spraying Orchards with High-Volume Dilute Air Blast Equipment Based on Short-Sleeved Open-Neck Shirt, No Gloves or Hat and Based on the Assumption that the Clothing Worn Gave Complete Protection of the Areas Covered**

| Body Part                     | Pad Location or Area Rinsed | No. of Samples | Body Part Area (sq ft) | Parathion Recovery (mg/sq ft/hr) | Parathion Exposure (mg/body part/hr) |
|-------------------------------|-----------------------------|----------------|------------------------|----------------------------------|--------------------------------------|
| Face                          | Shoulders                   | 134            | 0.70                   | 7.0                              | 4.9                                  |
| Front of neck<br>"V" of chest | "V" of chest                | 65             | 0.16                   | 2.6                              | 0.4                                  |
| Back of neck                  | Back of neck                | 62             | 0.12                   | 5.7                              | 0.7                                  |
| Forearms                      | Forearms                    | 131            | 1.30                   | 7.3                              | 9.5                                  |
| Hands                         | Hands                       | 113            | 0.87                   | —*                               | 3.9                                  |
| Total Dermal Exposure         |                             | 505            | 3.15                   | —                                | 19.4                                 |

\*Rinse of total hand area.

**Table 4.—Potential Dermal Exposure Values for Workers Operating Air-Blast Spray Machines in Orchards, Comparing Exposure Based On Use of Minimum Amount of Protective Clothing vs. Protective Clothing Actually Worn**

| Pesticide Compound | Mg per Hour of Exposure <sup>a</sup>               |      |                                     |      |
|--------------------|----------------------------------------------------|------|-------------------------------------|------|
|                    | Based on Minimum Amount of Protection <sup>b</sup> |      | Based on Clothing Worn <sup>c</sup> |      |
|                    | Range                                              | Mean | Range                               | Mean |
| Parathion          | 3.4 - 148.0                                        | 28.8 | 1.6 - 80.9                          | 15.9 |
| Azinphosmethyl     | 1.1 - 146.2                                        | 31.8 | 0.8 - 47.0                          | 15.7 |
| DDT                | 7.9 - 140.6                                        | 39.1 | 4.8 - 124.9                         | 22.6 |

<sup>a</sup>Mean of 25 values for each compound.

<sup>b</sup>Short-sleeved, open necked shirt, no gloves or hat and based on assumption that clothing worn gave complete protection of areas covered.

<sup>c</sup>Amount of exposed skin areas estimated from observations of workers applying pesticides during exposure studies.

Dear Dr. Preston:

I have your letter of April 7, 1972 in which you have asked me to serve on a Conference on Protective Clothing and Safety Equipment for Pesticide Workers. Unfortunately, my schedule is extremely full at this time, and I am unable to attend your conference.

I would like to convey several thoughts to you since I will be unable to present them personally. I will also include several publications that I have prepared and that are widely used throughout California and the United States. The first is a complimentary copy of our *University of California Pesticide Information and Safety Manual*. The second is "Basic Rules for the Safe Handling of Pesticides," one in English and one in Spanish.

From personal experience in the state of California over the past 18 years, I have found that commercial pesticide applicators, farmers, and others who are using pesticides are generally aware that they are supposed to wear protective equipment during the mixing and application of the more toxic pesticides. In reality, many of them do not choose to wear washable hard hats, goggles, boots, respirators, rubber gloves, or pesticide impervious coveralls. Their excuses are that the equipment is too hot and restrictive under most of our growing conditions. The only way that I can see that we can get more of these people to wear such equipment is through closer supervision by local supervisors who are on the job.

Another observation that I have made is that even though many people do wear at least some protective equipment, it is frequently extremely contaminated while they are wearing it or even before they begin to wear it. Thus, they have to be taught to use clean equipment.

In some areas of our state, even though farmers and others would like to purchase protective equipment they have to drive many miles in order to find it, and even then, the person who is selling it to them knows little, if anything, about how effective this equipment would be. We may have to insist or pass legislation requiring any pesticide dealer to also sell protective equipment. In this regard, I would think it advisable for this dealer to be examined in writing regarding the effectiveness of the protective equipment he sells.

Lastly, I find it extremely difficult to obtain lists of approved respirators from the U.S. Bureau of Mines, such as the one published by the U.S. Department of Agriculture, Agricultural Research Service, February 1966. We need to know specifically by brand name of the respirator which pesticide this respirator will afford protection against. If your committee does nothing else, it would be a tremendous service if we could be provided with the latter.

If I can assist you later on in your committee, please do not hesitate to ask me.

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## BASIC RULES FOR SAFE HANDLING OF PESTICIDES

by

*J. Blair Bailey  
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### 1. Pre-seasonal preparation

- A. Contact your physician for cholinesterase base-line test if you plan to use phosphate or carbamate insecticides.
- B. Inform physician of types of pesticides you plan to use.
- C. Confirm that your physician has the up-to-date telephone numbers of Poison Control Centers and a copy of the California Department of Public Health's technical bulletin for physicians entitled: "Diagnosis and Treatment of Phosphate Ester Pesticide Poisoning."
- D. Post these emergency telephone numbers by your telephone.
  - 1) Physician
  - 2) Poison Control Center

### 2. Selection of a Pesticide

- A. Know the pests. (If you need assistance, call your local University of California Farm Advisor.)
- B. Select right pesticide for the job.
- C. Read the label.
  - Pay special attention to warnings and precautions *before* opening container.
- D. Consider hazards to humans, livestock, pets, bees and wildlife.

### 3. Before Using Pesticides

- A. Have plenty of clean water and soap readily available.
- B. Have a clean change of clothing.
- C. Know first aid procedure. (See item 7, page 3.)
- D. Have proper protective equipment, if directed on the label.
  - 1) Clean hat, gloves, goggles, clothing.
  - 2) Check respirator for a clean filter and gloves for holes.
- E. Check application equipment for proper functioning, leaking hoses, or connections.

### 4. Handling and Applying Pesticides

- A. Observe label directions.
- B. Wear proper and clean protective equipment.
- C. Handle concentrated pesticides with extreme care.
- D. Never eat, smoke, or drink while handling pesticides.
- E. Never work alone when applying hazardous pesticides.
- F. Stay out of the drift and the runoff as much as possible.
- G. Don't apply pesticides when drift will be a problem to humans, livestock, pets, bees, wildlife and crops.
- H. Never use more than the recommended amount of chemical.

### 5. Storage of Pesticides

- A. Store pesticides in locked, dry cupboard or shed out of reach of children and other unsuspecting people.
- B. Never store pesticides with or near food, feed, or liquids for drinking.

#### 5. Storage of Pesticides (Continued)

- C. Store pesticides in the *original labeled* container.
- D. Do not store herbicides or defoliants containing chlorates with other pesticides. They can cause fire or explosion.
- E. Always keep lids and bungs tightened when containers are not being used.
- F. Keep all "empty" containers in secure storage area until disposed of properly.
- G. Do not store application equipment in same building with pesticides. In case of fire, equipment will burn also.

#### 6. Disposal of Pesticides and their Containers

- A. Dispose of unwanted pesticides in ground where contamination of crops or drainage will not be a problem.
- B. Return "empty" drums to supplier or cooperage firm as soon as possible.
- C. Combustible containers – Burn (*except* hormone type or those containing chlorates). Check with your county agricultural commissioner regarding legality of burning.
- D. Glass containers – Rinse, break and put in dump. Call your county agricultural commissioner for location of nearest dump approved to accept pesticides and containers.
- E. Metal cans – Rinse, puncture (top and bottom) and put in dump.
- F. Aerosols – *Never burn or puncture*; put in dump.
- G. Never stand in fumes or smoke of burning pesticides or containers.
- H. If burning is not permitted, destroy container (with gloves still on) then put in dump or bury.

#### 7. First Aid

- A. Start artificial respiration immediately if patient is not breathing.
- B. Stop exposure to poison *immediately*. (Get patient to physician as soon as possible.)
- C. Remove contaminated clothing.
- D. Wash thoroughly with plenty of clean water and soap.
- E. If a pesticide has been swallowed (except petroleum products), induce vomiting immediately.
- F. Never give anything by mouth to unconscious or convulsing person.
- G. For eye contamination, wash immediately with clean water for at least ten minutes.
- H. If victim is in confined space
  - 1) do *not* enter without proper protective equipment.
  - 2) remove victim – open doors and windows.

Dear Dr. Preston:

One thing the panel on safety equipment and protective clothing did not react to was the choice of headgear for pesticide applicators. During the first day's talk Sou'wester and other style hats were indicated as not giving adequate protection to the eyes or neck. Hoods that could be flipped back onto the shoulders are a booby trap for collecting pesticide dusts that will later be dumped on the applicator's head when he wants to use the hood again. What would be an adequate style of headgear?

I'm not sure whether the group decided to limit its concern to clothing and equipment and not try to hash out safety practices. However, I think that if the ANSI literature should become a reality, it should include cautions also against using particular kinds of clothing such as tight fitting clothes, pants with cuffs, leather shoes, parka hoods, or substitutes for the approved special protective equipment.

The conditions under which some equipment is worn which lessens its effectiveness should be part of evaluating equipment. For example, wearing a beard negates the protection of a gas mask because of an inadequate seal with the face. Facial contour may also effect adequacy of seal.

Perhaps the aforementioned comments would be covered under point C of the panel report.

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